WEST NILE VIRUS:

Surveillance and Prevention in Ontario, 2001

The Ontario Ministry of Health and Long-Term Care

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1.0 Introduction and Purpose of this Document

Introduction

The West Nile Virus (WNV) can cause an arthropod-borne disease in birds, mammals and humans. The virus was first isolated in Uganda in 1937, and since then, has been a well-documented cause of disease in Africa, West Asia, and Eastern Europe. Prior to 1999, however, WNV had never been detected in the Western Hemisphere. During the summer and fall of 1999, the virus was responsible for 61 human cases of encephalitis, including 7 deaths, in New York City (primarily the borough of Queens) and its surrounding counties. In the summer and fall of 2000, there were 21 confirmed human cases of WNV disease, including two fatalities, in three northeastern U.S. states. Fourteen of the cases resided in four counties of New York and the epicenter was on Staten Island. In addition to the human cases, WNV infection was confirmed in hundreds of birds, mainly *Corvids* (crows, ravens and jays), as well as in several horses, other domestic animals and wildlife in the U.S. In the year 2000, 143 counties in 12 states had evidence of WNV activity in mosquitoes, birds or mammals. All but one of the 62 counties of New York State found evidence of the virus. Mosquitoes are the primary vectors of West Nile Virus, mainly the *Culex pipiens/restuans* species of mosquito, which preferentially feeds on birds, but also on humans and other mammals.

Purpose of this Document: Surveillance and Prevention

The primary purpose of this document from the Ontario Ministry of Health and Long-Term Care (MOHLTC) is to describe the Surveillance Plan for West Nile Virus (WNV) in the Province of Ontario for the year 2001, and the Prevention and Public Education measures aimed at reducing the risk of WNV disease for the population of Ontario.

In brief, the Surveillance section of this document describes:

- the surveillance systems to identify West Nile Virus in birds, mammals and mosquitoes, and
- the enhanced passive surveillance system for human cases of WNV disease.

In 2001, the Surveillance Plan for WNV in Ontario is focused on detecting evidence of WNV in dead birds, primarily of the *Corvid* family, and in humans who have the clinical presentation of acute encephalitis or meningitis, which are reportable and communicable diseases under the regulation in Ontario. The 2001 Surveillance Plan is based on the surveillance experience in Ontario during the 2000 season and the recommendations of the National Steering Committee for WNV (of which the MOHLTC is an active participant).

Preventing WNV disease requires *actions* and a *strategy* to prevent or reduce human exposure to the disease vectors, i.e. the species of mosquitoes capable of carrying and transmitting the virus to humans (as well as to birds and mammals). The key preventive *actions* are commonly called: (1) "**source reduction**" (reducing or eliminating mosquito breeding sites), and (2) "**personal protective measures**" against mosquitoes. The key *strategy* for implementing these preventive actions is through public education.

Although the unprecedented introduction of West Nile Virus in the Western Hemisphere in 1999 was a precipitating event for strengthening the infrastructure of public health, the WNV outbreak in the United States served as a reminder that new diseases and pathogens (whether arthropod-borne or not) may emerge in the future. As Ontario moves forward to prevent the occurrence of WNV disease and to minimize its potential health impact, the strengthened infrastructure and communication networks may form a cohesive multi-agency approach for responding effectively to other newly-emerging agents of disease.

2.0 The Epidemiology of West Nile Virus

2.1 Background

West Nile Virus (WNV) can cause disease and mortality in many species of birds and mammals, the latter including humans. Taxonomically, this arthropod-borne virus ("arbovirus") belongs to a family of flaviviruses (*Flaviviridae*) and more specifically, to the "Japanese encephalitis serocomplex" of viruses, which includes the St. Louis encephalitis virus (closely related to WNV), Japanese encephalitis virus, the Kunjin and Murray Valley encephalitis viruses, and other flaviviruses.

The arthropods (vectors) which carry and transmit WNV are mosquitoes -- mostly bird-feeding species such as *Culex* but also other genera and species of mosquito – and (in the "Old World") ticks; "soft ticks" (argasids) and "hard ticks" (ixodids). The virus propagates in nature through primarily a "bird-mosquito-bird" cycle of transmission, but also a "bird-tick-bird" cycle where the ticks are feeding on reservoir birds. The urban cycle of the disease requires species of mosquitoes that feed on synanthropic or domestic birds and people. While birds comprise the primary "reservoir" hosts for the virus, mammals (including humans) are the "incidental" or "dead-end" hosts. In endemic areas, the virus has been isolated from mammals such as horses, camels, cattle, mice, hamsters, dogs, bats, and lemurs.

WNV was named after first being isolated in the West Nile province of Uganda in 1937 and since then, has been a well-documented cause of human disease in Africa, West Asia, and Eastern Europe. The first reported epidemics occurred in Israel during 1951-1954 and in 1957. European epidemics of WNV encephalitis have occurred in southern France in 1962, in southeastern Romania in 1996, and in south-central Russia in 1999. The largest recorded WNV epidemic occurred in South Africa in 1974. A major epidemic, with considerable mortality, began in Israel in the latter part of 2000.

Prior to the summer of 1999, West Nile Virus was never identified in the Western Hemisphere. The first known emergence of WNV in the Americas occurred in New York City in the late summer and fall of 1999, an epidemic which caused 61 confirmed human cases of encephalitis, of which seven were fatal. The method of importation of WNV is unknown, but it may have arrived in an infected human or bird (including a migratory bird) or mosquitoes. Genetically, the 1999 New York City strain of the virus most closely resembled a strain identified in Israel in 1998.

In most infected persons, WNV causes asymptomatic illness or a mild febrile, "flu-like" illness, sometimes with a rash. In a minority of patients – usually the elderly or immunocompromised, WNV infection causes severe illness manifesting as acute encephalitis (or rarely, meningitis), the fatality rate of which is about 10-15%. Among the persons in New York City who developed encephalitis, severe muscle weakness was a prominent feature, occurring in 40% of the confirmed cases.

A serosurvey conducted in October 1999 in the Borough of Queens (the area of highest WNV incidence), demonstrated WNV antibody in 19 of 677 people aged 5 years and older; i.e., or 2.6% (95% confidence interval, 1.2 - 4%). Most of these persons reported having no symptoms or just a mild "flu-like illness". These findings were comparable to those in the 1996 outbreak in Romania.

During the winter of 1999-2000, the virus survived in mosquitoes in the New York City sewer system, and WNV was also detected in a non-migratory red-tailed hawk found dead in Westchester County, New York, in February 2000.

In the year 2000, there were a total of 21 confirmed cases of human infection in the U.S., of which two ended in death. The geographic distribution of human WNV infection spread to three states (New York, New Jersey and Connecticut) but most affected persons lived in or close to New York City. The 2000 epicenter was Staten Island, which had 10 of the 14 New York City cases. A serosurvey conducted in Staten Island at the end of the season identified four out of 871 people tested for antibody to WNV, for a seroprevalence of 0.46%.

In both years, the outbreaks killed several thousand native wild birds, mainly *Corvids*: crows (especially the American Crow), jays, ravens and magpies. WNV also caused deaths in other native wild birds, as well as Chilean flamingoes (in the Bronx Zoo, 1999) and unspecified species of pheasants and cormorants. In the "Old World", WNV usually causes asymptomatic or mild illness in birds but its emergence in North American has been associated with high rates of mortality among a number of bird species. In mammals, the virus caused neurological disease in at least 22 horses in 1999 and in 59 horses in 2000, about half of which died or had to be euthanised.

2.2 Risk of a WNV Outbreak in Ontario in the 2001 Season

The risk of WNV emerging in Ontario during the coming mosquito season is unknown, but during the 2000 season, WNV-positive dead birds were found in 61 of the 62 counties of New York State, including one found in Tonawanda (Erie County), only 3 kilometres from the Ontario border.

If introduced into Ontario, viral activity may be geographically localized, as it initially had been in New York City, or it may be multi-focal. The ecology of WNV is still being defined, and as it was recently introduced into North America, more study is required of the species of birds or mosquitoes in which the virus may "overwinter" into the next season. Evidence that the virus overwintered came from New York State: live virus was detected in February 2000, in mosquitoes in the sewer system in New York City (epicenter of the outbreak in 1999 and 2000), and in a red-tailed, non-migratory hawk found dead in nearby Westchester County. As well, there is the possibility that migrating birds could become infected while co-mingling with infected birds in the southeastern U.S.A. over the winter, and return to areas throughout central

or eastern Canada. Birds themselves do not pose a risk to human health, but are preyed upon by mosquitoes, which in turn can bite and infect human hosts.

The unexpected emergence of WNV in North America has underscored the ease with which human or animal pathogens can move between the world's population centres. The new ecology of the virus in North America requires much further study. There remains the possibility that migrating birds could become infected while co-mingling with infected birds in the southeastern U.S.A over the winter, and return to areas throughout central or eastern Canada. Overall, the emergence of WNV in North America has brought to the fore the issues of the preparedness -- and the availability of infrastructure, resources and expertise -- of official agencies, including public health agencies, in order to detect, monitor, control and prevent the spread of vector-borne diseases among human and animal populations.

3.0 A Plan for Ontario: West Nile Virus Surveillance, 2001

Key changes in 2001 to surveillance activities in Ontario include:

- the discontinuation of sentinel chicken surveillance, which had an extremely low yield in the United States surveillance system in 2000;
- the discontinuation of weekly mosquito surveillance in southern Ontario health units; mosquito surveillance will be instituted only following identification of WNV in other species (see below); and
- the discontinuation of active surveillance for human viral meningoencephalitis and reliance on enhanced passive surveillance.

3.1 Dead Bird Surveillance

Because sudden mortality among birds, especially Corvids (crows, ravens and all jays) -- may manifest as clusters of bird deaths, and may be an early indicator of WNV in the locality, dead bird surveillance will be a vital part of WNV surveillance activities and may provide an early warning locally.

Dead bird surveillance is not normally a public health activity, because dead birds are rarely associated with a risk to human health. In the instance of WNV, however, dead bird sightings and specimen collection are the vital surveillance activities for early identification of the presence of WNV in the locality.

The following dead bird surveillance activities will be carried out in 2001:

1. reporting of dead Corvid (crows, ravens and all jays) sightings province-wide;
2. submission of Corvid species (crows, ravens and all jays) for WNV testing from the "Southern Zone" of local health units in Ontario, and from the "Northern Zone" only in the event of antecedent clusters of Corvid die-offs.*

* For the purpose of this surveillance plan, the "Southern Zone" is defined as all local health units in Southern Ontario with the exception of Muskoka-Parry Sound and Renfrew. The "Northern Zone" comprises the other health units, i.e., those in the Northeast and Northwest Ontario Public Health Regions, with the addition of Muskoka-Parry Sound and Renfrew.

For further details concerning the protocol for reporting and submission of dead bird specimens in Ontario, please refer to the protocol in Appendix 1, "*Species of Particular Concern, Handling and Submission of Specimens - Ontario West Nile Response*", by Dr. Ian Barker of the Canadian Cooperative Wildlife Health Centre (CCWHC), in Guelph. Below is a summary of the protocol.

The public is advised not to handle dead birds, but to call the local health unit to report the finding of dead birds. Upon receiving the call, the health unit staff person should follow advice provided in the protocol. An assessment over the telephone should be made about whether the carcass should be submitted for testing to the CCWHC. Unlike 2000, bird carcasses which exhibit signs of trauma, injury, emaciation or predation, e.g., injury from a cat, should be submitted, as a high proportion of positive birds identified in New York State in 2000 demonstrated such signs, indicating that infected and moribund birds are more susceptible to such injuries. Bird die-offs suggestive of a history of poisoning, e.g., bird control near a feed mill, should not be reported nor submitted for WNV testing. Specimens must be fresh and therefore lack evidence of putrefaction, maggots or scavenging. As well, only birds listed under "*Species of Particular Concern*" should be collected and no more than 8 carcasses per locality should be submitted during a die-off. The finding of WNV in a neighbourhood precludes the submission of further specimens from that area. If local health department staff require further advice on the merits of submitting a specimen, they may call the Guelph CCWHC at (519) 823-8800, ext. 4662.

If local health department staff decide to submit the specimen, a public health inspector is to retrieve and package the specimen. The carcass(es) should be handled according to the information in Appendix 1 under "*Handling Birds*". The required supplies, packaging information, the appropriate specimen laboratory form to accompany each submission and instructions on where to ship the specimens are addressed in the CCWHC document. The specimens are to be shipped by *Purolator Courier* and an account number will need to be written on the waybill to avoid payment. As described under "Address for Shipping" local health department staff will need to phone the CCWHC, Guelph, when the first specimen is being sent to get the account number. The same number is to be used for subsequent shipments. It is important that the contents of the package be described only as "DIAGNOSTIC SPECIMEN - WILDLIFE" on the waybill.

In the event that a carcass will not be collected by a public health inspector, the public should be advised not to handle the bird but to bury it under at least two feet of earth or to place the carcass in a double bag for garbage, and ultimately landfill disposal. While the WNV is not transmitted through handling of bird carcasses, it is felt prudent not to involve the public in the direct handling of these specimens.

To facilitate dead bird submissions, the field offices of the Canadian Food Inspection Agency (CFIA), the Ministry of Natural Resources (MNR) and the Ministry of Environment (MOE) will be requested to refer calls from the public to the nearest health unit. If, however, an avian specimen is brought to an MNR office or if MNR has evidence of an avian die-off, they will investigate and provide specimens to the Guelph CCWHC.

3.2 Enhanced Passive Human Surveillance

To stimulate passive reporting, the Ministry of Health and Long-Term Care (MOHLTC) will carry out a direct mailing in May 2001 to all specialty physicians in Ontario in infectious diseases, neurology, emergency medicine and intensive care, as well as to all hospital CEOs and infection control practitioners, about the need to consider West Nile Virus encephalitis in the differential diagnosis of meningoencephalitis, and the appropriate diagnostic specimens to collect.

As well, local health departments are requested to contact approximately 60 hospitals in southern Ontario to provide advise, protocols as required, and establish prompt diagnostic efforts and reporting of suspect cases to the local medical officer of health as required under Regulation 559/91 under the *Health Protection and Promotion Act* . Cases that meet the case definition (see page 24 in Appendix 2, "*Canadian National Guidelines for Human Surveillance for West Nile Virus*") should be reported to the Public Health Branch through RDIS at the next scheduled weekly electronic transmission. RDIS is being enhanced to allow entry of West Nile Virus under agent/organism for the disease, encephalitis/meningitis.

The Ontario human surveillance program is consistent with the *Canadian National Guidelines for Human Surveillance for West Nile Virus* (Appendix 2).

3.3 Mosquito Surveillance

For 2001, testing of mosquito pools to detect WNV will be done only in the event of confirmation of WNV presence in a bird, mammal or human in the locality.

Both mosquito CDC light and gravid traps will be warehoused by the MOHLTC for use as required in the event of a positive finding of WNV. The purpose of mosquito surveillance following identification of WNV will be:

- to speciate the mosquitoes in the vicinity of populated areas in order to inform mosquito control activities, including the most appropriate time of day to apply adulticide
- to enumerate mosquitoes in areas targeted for mosquito control activities in order to monitor reduction in mosquito counts as a result of such control activities
- to identify the age structure of the mosquito population in the area, which will identify the extent of blood-feeding and egg-laying in the mosquito population, which correlates with risk of transmission of the virus to humans

Following the identification of WNV activity in a health unit area, and upon consultation with MOHLTC staff, local municipal or regional staff may identify appropriate locations for the siting of mosquito traps, place and maintain the traps at selected locations, and collect mosquitoes from these traps at a predefined frequency, depending on the purpose of establishment of the trap (e.g., daily if monitoring effectiveness of adulticide application). Three traps per area of 2 mile (3 km) radius would likely suffice. Three kilometres equals approximately 2 miles, the radius used empirically in most U.S. jurisdictions for adult mosquito surveillance and control (adulticiding or larviciding) during the 1999 and 2000 seasons. A two-mile radius is also thought to be a generally-adequate outer limit of flying distance for adult *Culex* species mosquitoes. *Culex pipiens*, the most common vector for WNV in the U.S., tends to migrate little and stays around the containers in which it breeds. Less is known about the flight habits of *Culex restuans*, but they are very closely related genetically to *Cx. pipiens*. *Aedes* species adult females may travel farther, as they seek temporary floodwater sites to lay eggs, but they are less frequent vectors of WNV.

3.4 Enhanced Passive Animal Surveillance

The Ontario Ministry of Agriculture, Food and Rural Affairs will inform all veterinarians in Ontario through the College of Veterinarians newsletter to consider WNV as a differential diagnosis when signs of encephalitis are presented. The CFIA laboratory in Ottawa will test the suspect brain tissue for WNV if rabies is ruled out. The WNV in New York State most prominently affected horses.

3.5 Enhanced Surveillance in the Event of Confirmed WNV Activity

The following enhanced surveillance activities should be considered in the event of finding WNV activity in a non-human species within, or immediately adjacent to, Ontario:

Enhanced Human Surveillance:

The local Health Unit (LHU) may notify appropriate local physicians about the finding of WNV activity and the possibility of human illness. Physicians should be informed about the clinical spectrum of illness and be given instructions on appropriate diagnostic specimen collection. The number and types of physicians notified will depend on the local area (e.g., rural vs. large urban).

Enhanced Bird and Mammalian Surveillance:

Avian and mammalian surveillance data will be used by provincial and local agencies and institutions responsible for disease control, along with surveillance data from human case reports and surveillance testing. Specific recommendations for the use of bird/mammal surveillance data are the following:

- Evidence of a single dead Corvid or other targeted bird species does not provide definitive evidence of local virus presence, since it is extremely difficult, without the results of laboratory testing, to determine the Corvid's cause of death.

- If a municipality receives reports of multiple dead Corvids (or other targeted bird species), the local Health Unit should take immediate action to collect and submit fresh specimens of dead birds for specific diagnostic testing for WNV.

- If clusters of bird neurological illnesses or deaths, or of neurological illness in mammalian species, are detected, priority should be given to prompt laboratory confirmation of the cause. If these illnesses occur in chickens or domestic mammals, the lead agencies will be the Canadian Food Inspection Agency and the Ontario Ministry of Agriculture, Food and Rural Affairs.

- Whether in one's own jurisdiction, or in an immediately-adjacent municipality or Health Unit, if WNV is laboratory-confirmed in a bird or mammalian specimen, or if WNV is strongly suspected based on histopathological examination or other methods, the following surveillance activities should be considered in one's own jurisdiction:

  - active surveillance for human illness;
  - continued dead Corvid sightings and submissions;
  - mosquito surveillance (trapping, counting, speciation, and testing for WNV) in the immediate vicinity of the positive bird or mammal.

- In interpreting the evidence of a laboratory-positive bird or mammal, the following considerations should be included:

  - What are the probabilities of false positives and false negatives with the specific laboratory test used?

  - Does the laboratory test and/or clinical history support the infection being current rather than from a prior year's exposure?

  - Is there evidence that the positive bird or mammal acquired the infection locally, or could the infection have been acquired elsewhere through migration or travel?

  - If the infection is not likely due to travel or migration, is this finding of WNV new to this geographic area? The first finding should be associated with as much certainty as possible, whereas once WNV is established in an area, the specificity of diagnostic testing improves.

  - Is there other supporting evidence of WNV in or near the geographic area, such as suspect human cases?

3.6 Reporting Positive Findings of West Nile Virus

See Appendix 3, "*Reporting Routes and Timing*".

4.0 West Nile Virus: Prevention and Public Education

4.1 Introduction

In order to reduce the possibility of human contact with mosquitoes which are potential vectors of West Nile Virus disease, two key types of *preventive actions* are recommended from a public health perspective: (1) source reduction; the reduction or elimination of actual or potential environmental habitats for mosquitoes (primarily their breeding sites but also their resting sites) – and (2) personal protective measures that individuals can take to avoid, block or repel biting mosquitoes.

The important *strategy* for implementing these preventive actions is through public and stakeholder education, including the use of effective communication products to convey accurate and timely information and advice on the disease and its causative agent, and the preventive actions to be taken to reduce the risk of acquiring the virus and consequent illness. Public awareness in the methods of personal protection against biting mosquitoes and in removing breeding sites from their properties can comprise an effective and environmentally-acceptable strategy in reducing disease risk.

Development and implementation of effective prevention measures against West Nile Virus requires knowledge about the life cycle including breeding and feeding habits of the mosquito species which can serve as vectors in transmitting the virus to humans or host animals. Although ticks can be vectors of WNV in the Eurasian and African continents, in North America (the United States) to date, only mosquitoes are known to transmit the virus. The most common vectors are those of the genus *Culex* and species *pipiens*, along with the closely-related *Culex restuans*. *Culex* mosquitoes preferentially feed on birds and secondarily, on humans and other mammals. WNV has also been isolated from *Culex salinarius* in the salt marsh areas around New York City. Other mosquito species found in the U.S. to carry the virus include: *Aedes vexans* and *Aedes albopictus*, *Ochlerotatus triseriatus* and *Ochlerotatus japonicus* (these were formerly in the *Aedes* genus), *Anopheles punctipennis*, and *Psorophora ferox*. Not all of these mosquito species are found in Ontario.

Appendix 4 lists those mosquito genera and species found in Southern Ontario and indicates which are the (so far) known carriers of WNV, the host preferences of selected mosquito species, their preferred breeding sites, and their respective life cycle patterns. In addition to these mosquito characteristics, knowledge of whether they are "daytime biters" or "evening (dusk-dawn) biters" influences the use of personal protective measures.

4.2 Biology and Life Cycle of Mosquitoes

Mosquitoes are insects belonging to the order *Diptera*, the True Flies. Like all True Flies, they have two wings, but unlike other flies, their wings have scales and their mouthparts (in female mosquitoes) form a long piercing-sucking proboscis. Males differ from females by having feathery antennae and mouthparts not suitable for piercing skin. Only female mosquitoes take a "blood meal" from a hosts -- amphibians, reptiles, birds, or mammals (including humans) -- in order to obtain a protein source for egg production. Males do not bite but feed on plant nectar, as females do to supplement their diets.

Mosquito larvae occur in discrete aquatic habitats. The most common nuisance species breeds in temporary rainwater pools of two to three weeks' duration. Vector species breed in all types of semi-permanent and permanent aquatic habitats. Unlike black flies, which breed in running water, mosquitoes tend to breed in still water. Eggs are laid singly or in rafts on the water surface. Larvae emerge and eventually change to a pupa which, in turn, change to adults.

In the spring, the first group of mosquitoes to emerge that bite humans include the "spring *Aedes* species". These are predominantly *Aedes stimulans, Aedes trichurus* and *Aedes implicatus*. They breed in winter snow melt pools and produce only one generation of adults per year and peak biting time is late May to early July.

In the summer, the second group of mosquitoes to emerge that bites humans includes the "summer *Aedes* species". These are primarily *Aedes vexans* and *Aedes dorsalis*. They breed in temporary warm-water flooded pools (usually present after heavy rains) and may produce many generations over the summer, especially in years of heavy rainfall and warm temperatures.

The *Culex* species are not major biters of humans, preferring birds as hosts. *Culex* prefer to breed in permanent stagnant (standing) water in mid- to late summer. When populations of this species increase due to favourable weather and other conditions, they will often find other hosts in addition to birds on which to feed. This creates a potential for the transmission of an arbovirus such as St. Louis or West Nile encephalitis virus. Although other mosquitoes may be involved in acting as vectors of an arbovirus, *Culex pipiens* is the predominant species of mosquito linked to West Nile Virus and St. Louis Encephalitis. As an example, its biology and description is described in more detail in the following section.

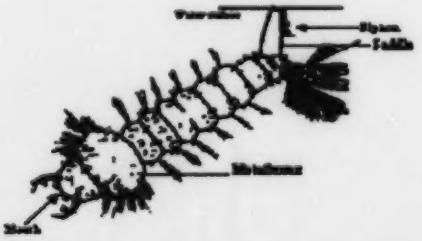
Life Cycle of *Culex pipiens*

Culex pipiens, the "Northern house mosquito", goes through four separate and distinct stages of its life cycle: Egg, Larva, Pupa, and Adult. Each of these stages can be easily recognized by its special appearance.

Egg: Eggs are laid one at a time and they float on the surface of the water stuck together in rafts of a hundred or more eggs. *Culex* females lay their eggs on water that is high in organic material and stagnant. The water may be in tin cans, barrels, horse troughs, ornamental ponds, swimming pools, puddles, creeks, ditches, or marshy areas. Mosquitoes prefer water sheltered from the wind by grass and weeds. Most eggs hatch into larvae within 24 hours at 20-25° C and up to several days if cooler temperatures are prevalent. The eggs are not resistant to cold or desiccation. Most eggs are laid in early May but egg-laying continues until fall.

Larva: The larvae live in the water and come to the surface to breathe. They shed (*moult*) their skin four times between each instar, growing larger after each moulting. The larvae feed on micro-organisms and organic matter in the water. On the fourth moult, the larva changes into a pupa. Larval development is completed in approximately 60, 40 and 10 days at 10°, 15° and 25° respectively.

Identifying Larvae:



Instar	Characteristics
First	have a ridge on the upper surface of head, no ventral brush on the anal segment
Second	one hair tuft on each side of the metathorax
Third	two hair tufts on the metathorax
Fourth	complete saddle

Pupa: The pupal stage is a resting, non-feeding stage. This is the time the mosquito turns into an adult. The pupal stage takes about 1-4 days in spring and 2-3 days in summer before the adult is fully developed. When development is complete, the pupal skin splits and the mosquito emerges as an adult.

The egg, larvae and pupae stages depend on temperature and are more abundant in summers of extensive rainfall.

Adult: The newly emerged adult rests on the surface of the water for a short time to allow itself to dry and all its body parts to harden. The wings have to spread out and dry properly before it can fly. *Culex* mosquitoes usually lay their eggs at night. A mosquito may lay a raft of eggs every third night during its life span. The preferred host of *Culex pipiens* are birds. Most birds are bitten during the roosting time in trees.

Typical presence and abundance of life stages of *Culex* in Ontario

Month(s)	Life stages present and abundance
March to early May	female adults (mostly fertilized females) overwintering
Mid-May	adult females lay eggs
Late-May	eggs hatch to larvae, adult numbers decrease
Early-June	pupae develop and adults (male and female) emerge to mate
Mid-June	adult females lay eggs, adult numbers decrease
Late June	eggs hatch to larvae, pupae develop and adults emerge
Early August	larvae and pupae continue to develop and more adults emerge
Mid August	egg laying by adult females
Late August	larvae and pupae develop adult numbers decrease
Early Sept.	larvae and pupae continue to develop; females mate and ready for overwintering after first frost; males die
Mid Sept. to Feb	females overwinter

4.3 Source Reduction: Eliminating Mosquito Breeding Sites

Mosquito populations can be reduced preventively and often significantly by reducing the amount of standing water available for breeding. This preventive action is important since the *Culex* species, the commonest vectors of WNV, tend to breed in natural or artificial "containers" of standing water. Examples of source reduction actions are:

- Use of a geographic information system (GIS), geographic positioning system (GPS) or other mapping tools – available through Ministry of Natural Resources (MNR), Ministry of Municipal Affairs and Housing, or local Conservation Authorities – to determine permanent and temporary standing water sites that could be potential mosquito breeding areas. In some cases, improving drainage, filling in depressions, or regrading, can eliminate these sites. Changes to wetlands will require permission from MNR and Conservation Authorities.

- Old tires lying in yards can be significant breeding sites for mosquitoes. Water collects inside the tires and creates a perfect breeding site for some female mosquito species to lay their eggs. "Tire drives" can be sponsored at the local level in order to encourage citizens to bring in old tires for recycling.

- Flush storm drains, catch basins and drainage ditches at least once per week or after a light rainfall to remove stagnant water.

- Monitor sewer lagoons or retention ponds to ensure they are not breeding mosquitoes.

- Initiate door-to-door promotion of mosquito breeding source reduction to industrial, commercial, recreational and residential property owners.

- Adopt municipal "show by example" activities to encourage source reduction and promote these activities at shopping malls, schools, community centres, etc.

- Promote mosquito breeding site reduction campaigns through the insertion of fact sheets in with taxation or hydro bills

- Presentations/displays at retail garden outlets, senior centres, and gardening clubs in order to increase awareness of WNV among more vulnerable members of society (e.g., the elderly).

- Enact bylaws to require mosquito breeding site and source elimination or reduction.

- Construct and maintain ditches to improve drainage of water and contain run-offs.

- As the summer advances, monitor sites of temporary water collection (such as depressed grassy locations, poorly drained properties and other water-retaining structures) for larvae of summer *Aedes* and *Culex* 24 to 36 hours after a heavy rainfall, through mid-summer to fall.

Homeowners, and commercial, industrial and recreational property owners, may also be advised to eliminate actual or potential breeding sites on their own properties; for example:

- Children's tire swings can be a breeding site. It is easy to eliminate stagnant water that accumulates in tire swings and that provides a breeding site for mosquitoes by puncturing a hole in the bottom of the tire so that rain water may drain out.

- It is important to keep grass cut on a regular basis along with trimming shrubs and bushes throughout the summer. These are areas where adult mosquitoes like to hide during the day when they are not biting. They prefer shaded and moist areas.

- Fish ponds can be stocked with *Koi* or other mosquito eating fish (e.g., *Gambusia affinis*). Aerators, the removal of excess vegetation and proper construction will dissuade mosquitoes. Remove or fill in the pond if it is no longer wanted.

- Keep swimming pools, spas and hot tubs chlorinated, and if not in use tightly cover and keep rain water from accumulating on the cover.

- Change birdbath water frequently, at least once a week.

- Containers, buckets, pots, barrels, pans, cans, wheel barrows, etc., should be emptied, inverted, punched to create drainage holes, disposed of, or covered, to prevent mosquito entrance.

- Store small boats and canoes upside down, cover large boats to prevent accumulation of water, keep drains open. Ensure covers do not accumulate water.

- Construct sumps so that water does not stand or screen to prevent mosquito entrance.

- Store tires inside a garage or shed, cover to prevent water from accumulating or dispose of them through recycling programs.

- Tree holes are ideal breeding sites for certain mosquito species. Drain or fill them, or remove limb or tree.

- Plastic covers on lawn chairs and other outdoor equipment should be drained weekly to remove accumulation of rain or sprinkler water.

- Eaves troughs and rain gutters should be kept clean to allow proper drainage and to ensure that water does not stand.

- Shaded flat roof tops should be properly drained to ensure that standing water is eliminated.

4.4 Personal Protective Measures against Mosquitoes

It is not necessary to limit any outdoor activities unless there is evidence of mosquito-borne disease. However, the public can and should try to reduce the risk of mosquito bites. In addition to reducing stagnant water, screens should be installed and kept in good repair on windows and doors of homes and commercial buildings.

If West Nile Virus is found in a community, residents may be advised to:

- Minimize time spent outdoors between dusk and dawn when most mosquitoes are most active.

- Wear shoes, socks, long pants, and a long-sleeved shirt when outdoors for long periods of time, or when mosquitoes are most active. Clothing should be light colored and made of tightly woven materials that keep mosquitoes away from the skin. The use of mesh "bug jackets" or "bug hats" is recommended.

- Use mosquito netting when sleeping outdoors or in an unscreened structure and to protect small babies when outdoors.

- Consider the use of mosquito repellents, according to directions, when it is necessary to be outdoors:
  - Repellents should be applied only to exposed skin and/or clothing (as directed on the product label). Do not use under clothing.
  - Never use repellents over cuts, wounds, or irritated skin.
  - Do not apply to eyes and mouth, and apply sparingly around ears. When using sprays do not spray directly onto face; spray on hands first and then apply to face.
  - Do not allow children to handle these products, and do not apply to children's hands. When using on children, apply to your own hands and then put it on the child.
  - Do not spray in enclosed areas. Avoid breathing a repellent spray, and do not use it near food.
  - Use just enough repellent to cover exposed skin and/or clothing. Heavy application and saturation is unnecessary for effectiveness; if biting insects do not respond to a thin film of repellent, apply a bit more.
  - After returning indoors, wash treated skin with soap and water or bathe. This is particularly important when repellents are used repeatedly in a day or on consecutive days. Also, wash treated clothing before wearing it again.

Only insect repellents registered under the Canada's *Pest Control Products Act* should be used. Non-registered products (e.g., citronella candles, citronella plants, electronic insect zappers, and other magnetic devices) are not as effective as registered products in preventing mosquito bites.

Appendix 5 contains more the most recent recommendations ("safety tips") from the Pest Management Regulatory Agency (Health Canada) on the use of personal insect repellents in adults and children.

4.5 Public Education on West Nile Virus

"Public education" here refers to the composite strategy of activities designed to raise awareness and communicate accurate, timely, and useful information and advice to the public – in this context, about West Nile Virus and prevention measures to reduce the risk of acquiring the virus and subsequent illness. In addition to the general public, a communication strategy may identify other "stakeholders" – groups and organizations to whom informational messages should also be targeted. The methods for delivering public/stakeholder education include the posting of Web-based "fact sheets" and advisories, distributing printed materials, giving presentations to community groups, contacting the news media, making public service announcements, setting up a telephone "hot line", and so on.

The nature of the expected "audience" also influences the content of the educational "products". Basic information about the virus, how it is transmitted and what kind of illness can it cause – would be needed for the general public and the news media. Explaining that WNV is transmitted only by mosquitoes will allay any misconceptions that the virus can be spread by person-to-person, bird-to-person, or mammal-to-person.

Physicians and other health care providers would want to know more details about the clinical presentation and course of WNV illness (encephalitis, meningitis) and who is at greater risk (the elderly and immunocompromised). Similarly, veterinarians and animal care providers need to know what animals are at risk of infection and the clinical presentation. Community and professional groups concerned with the environment, wildlife and public health would be interested in the epidemiology of WNV (see Section 2.0 of this document) and its transmission cycle in nature.

The public and other stakeholders should also receive basic information about the surveillance activities being undertaken to detect and monitor the emergence of WNV. The public can be encouraged to report sightings of dead birds to their local public health department. Bird-watching societies can be informed about the focus on dead Corvids. Health care providers, especially those in acute care hospitals, will be informed about the human surveillance plan and reminded to report cases of encephalitis or meningitis that meet the suspect case definition for WNV and which are reportable diseases in Ontario anyway. The 2001 Surveillance Plan for Ontario has been described in Sections 3.0-3.5 of this document.

In terms of prevention measures, the general public may be advised about measures for personal protection against biting mosquitoes, including the application of approved insect repellent (as described in Sections 4.4 of this document). Outdoor recreational and tourism groups and senior citizens' residences may be targeted for advice on personal protective measures. Parents, schools and day cares need information on the use of DEET-containing repellent on children.

Public and stakeholder education is needed to encourage "source reduction": eliminating major sites of standing water on private properties (residential or commercial) and on public properties (e.g., wetlands, ditches, ponds, reservoirs, street catch basins, sewage treatment facilities, etc.). (See Section 4.3.) The importance of source reduction increases when mosquito breeding sites have been identified close to human conurbations and especially when West Nile Virus has been detected in the local area. Source reduction at the local/regional level may involve the municipal departments of Public Works or Parks and Recreation, local Conservation Authorities, and the property owners themselves.

Effective source reduction can decrease the need for chemical mosquito abatement or control – i.e., the use of approved insecticides against mosquito larvae and adults, termed "*larviciding*" and "*adulticiding*", respectively. Should "mosquitocide" still be indicated, the amount required can be lessened by preventive source reduction.

In the event that insecticide still needs to be applied in order to reduce the risk of WNV transmission by mosquitoes, public and stakeholder education will be needed to explain the facts about the pesticide: its toxicology and the risks of any adverse effects on human health (e.g., persons with asthma or allergies) or on the ecosystem, the latter including "non-target species" such as other insects (e.g., bees raised commercially for honey), fishes, and birds. The public and other stakeholders (e.g., environmental groups, commercial and occupational groups) would likely want to know the human health and ecosystem risks of the pesticide, weighed against the threat of WNV disease, as well as the "logistics" of how the larvicide or adulticide will be applied (when, where, by whom and by what means).

4.6 References from Other Agencies

Pesticides in general are approved ("*registered*") for use in Canada by the Pest Management Regulatory Agency (PMRA) of Health Canada, under the authority of the federal *Pest Control Products Act*. The active ingredient of the pesticide product, as submitted by the manufacturer, is evaluated on its toxicological properties, efficacy of use, expected benefit, and exposure risks to human and environmental health. For further information about pesticides, including those registered for mosquito abatement/control, the PMRA has a toll-free information line, 1-800-267-6315. The PMRA website (English) is: www.hc-sc.gc.ca/pmra-arla/english/index-e.html.

Registered pesticides must then be "*classified*", and placed in "schedules" for use, in Ontario by the Ontario Pesticide Advisory Committee (OPAC), which advises the Ontario Ministry of the Environment (MOE). Under the authority of the *Pesticides Act* (Regulation 914), the MOE regulates the sale, display, transport, storage, use, and disposal of pesticides. Through its central and regional offices, the MOE issues the licenses required for personnel to apply pesticides (following successful completion of a training course), as well as the permits that may be needed for applications in bodies of water or by aerial means. MOE Regulation also stipulates the requirements for public notification: how the public must be notified of when and where local pesticide application will take place. Finally, any unusual clustering of public complaints (in terms of location or time) may be reported to a regional MOE office for investigation into possible "misapplication" of pesticide.

Further information from the MOE and OPAC may be obtained from their websites at: www.ene.gov.on.ca and www.opac.gov.on.ca, respectively.

The use of chemical, as well as non-chemical, means of mosquito abatement/control has been reviewed by the National Steering Committee for West Nile Virus ("NSC-WNV"), chaired by Health Canada. The Ontario Ministry of Health and Long-Term Care is a member of this federal-provincial committee. Following the National Meeting of February 8-9, 2001, the NSC-WNV has drafted national recommendations for the year 2001, including "Levels of Response" to the presence of WNV. These "Response Levels" contain the recommended surveillance, prevention (public education) and mosquito abatement/control measures "in response to" the confirmation of WNV in a human or non-human species in a Canadian jurisdiction. *As of this date (early April 2001),* the final proceedings of the National Meeting, including the "Response Levels", are expected very shortly from Health Canada. Furthermore, Health Canada and the NSC-WNV have planned to produce the following documents for the 2001 season:, an updated "National Response Plan", a "Guide to Mosquito Control", and technical reviews of adulticiding and larviciding.

APPENDICES

1. **"Species of Particular Concern, Handling and Submission of Specimens - Ontario West Nile Response" and Incident Form**
2. **Canadian National Guidelines for Human Surveillance for West Nile Virus**
3. **Reporting Routes and Timing**
4. **Mosquitoes of Southern Ontario**
5. **Safety Tips on Using Personal Insect Repellents**

Appendix 1

West Nile Virus Response - Surveillance for Dead Birds
Species of Particular Concern, Handling and Submission of Specimens and Reports of Dead Bird Sightings by Ontario Health Units
Canadian Cooperative Wildlife Health Centre - Ontario Region
May 1, 2001

The Canadian Cooperative Wildlife Health Centre Ontario/Nunavut Region (CCWHC) at the Ontario Veterinary College, University of Guelph, as part of the Canadian West Nile Virus (WNV) surveillance program coordinated nationally by Health Canada and in Ontario by the Ontario Ministry of Health and Long-term Care, processes dead wild birds to detect West Nile Virus.

Health Units in Ontario participate in WNV surveillance by submitting bird carcasses to CCWHC for virus detection and by reporting sightings of dead birds. This document provides a brief background on West Nile Virus. It also describes in detail how bird carcasses can be handled safely to arrive at the laboratory in good condition for examination, and how sightings of dead birds that cannot be submitted should be reported.

WHAT IS WEST NILE VIRUS AND WHY IS IT CAUSE FOR CONCERN?

! West Nile Virus is an arbovirus (arthropod-borne virus), transmitted by the bites of infected arthropods, mainly mosquitoes (about 50 species worldwide) and, to a lesser extent, ticks. As well, virus is present in secretions and excretions of infected birds, and direct transmission from crow-to-crow has occurred under experimental conditions. Direct transmission from animal-to-person or person-to-person is not known to occur naturally. West Nile Virus is quite susceptible to sunlight, drying, heat, freezing at usual temperatures, and simple disinfectants, so it should not survive long in the environment, or on skin of a the person who uses simple hygiene such as washing with soap and water.

! Prior to 1999, West Nile Virus was known only from Africa, Asia and Europe, and had never been recognized in the Western Hemisphere. However, in 1999 WNV emerged in New York, New Jersey and Connecticut, and in 2000, its distribution expanded to encompass the area from the Ontario and Quebec borders in the north to North Carolina in the south, and from Atlantic Ocean in the east to the south shore of Lake Erie in the west. It appears probable that it will invade Canada in 2001, if it has not already done so.

! Wild birds are the primary hosts, but the virus also may infect amphibians, domestic poultry, domestic mammals, human beings, non-human primates, and various species of wild mammals.

! The virus multiplies in the tissues of an infected bird, circulates in the blood, and may be picked up by another mosquito when it feeds. The virus also multiplies in infected mosquitoes, which transmit the virus when they feed on another bird. After introduction into a locality, the virus undergoes several cycles of infection (amplification) in mosquitoes and birds, with each cycle increasing the number of infected birds and mosquitoes. Amplification involves mainly mosquito species that preferentially feed on birds, but once large numbers of birds and mosquitoes are infected, the chances of an infected mosquito biting a mammal increase. 'Bridge vectors', mosquitoes that feed on both birds and mammals, also may transmit the virus to mammals.

! Most individual infected birds do not become ill, but over 60 species are known to be susceptible to disease, which results from inflammation in many organs, including the brain (encephalitis). Crows and

blue jays, both members of the family Corvidae, are unusually susceptible; many infected crows and blue jays die.

! Although most infected mammals do not become ill, a few individuals of certain species, especially people and horses, and rarely, dogs and cats, and a few wild mammals may develop encephalitis due to WNV.

! In humans, West Nile Virus may cause mild disease with fever, frontal headache, muscle aches, swollen lymph nodes and skin rash. Less commonly it causes severe disease that is marked by headache, fever, neck stiffness, muscle weakness, stupor, disorientation, coma, and possibly death. Disease usually is more severe in the elderly. The incubation period (interval between infection and the onset of disease) in humans is usually 5 to 15 days.

! Antibiotics or other specific medications are not effective against this infection, and no vaccines against this virus are approved for use in people or animals.

! Personal protective measures to take against WNV include avoiding known infected areas; draining or eliminating local mosquito breeding sites if possible (bird baths, cisterns, old tires etc. where water collects); using effective screens on windows and doors of dwellings; staying indoors when mosquitoes are active, especially at dusk and dawn; wearing long clothing; and using an effective repellant - DEET.

WEST NILE VIRUS 1999-2000

West Nile Virus may have been introduced to the New York area by migratory birds, legal or illegal imports of birds, in a traveler from overseas who was incubating the virus, or by infected mosquitoes in an aircraft. The exact means of introduction probably never will be known. The strain involved is closely related to one that has been circulating in Israel over the past few years. In mid August, 1999, wild crows were found dead at the Bronx Zoo in New York City. About the same time, there were reports of encephalitis, originally thought to be due to St. Louis Encephalitis, a related arbovirus, in people in New York City. By late August, dead crows were reported in many parts of downstate New York and Long Island. Deaths in captive birds began in the Bronx Zoo in early September and continued over a three-week period. Unusual mortalities of wild birds occurred into early November on Long Island, downstate New York, and adjacent New Jersey and Connecticut within an approximately 200 km radius of New York City. Cases of encephalitis in horses were first seen on Long Island in late August, and continued to occur into October. West Nile Virus was isolated from affected wild birds, zoo birds, people, horses, a cat and mosquitoes. The 1999 New York area outbreak caused encephalitis in at least 60 people and resulted in 7 human deaths, including one Canadian who visited New York City from Toronto. It has been estimated that about 1200 (2.6%) of the 46,000 people living in North Queens, NY, at the centre of the outbreak, became infected. About 30% of infected people reported a flu-like illness at the time of the outbreak, compared with 11% of those who were not infected. About 40 people in North Queens developed WNV encephalitis, and several were among those who died. WNV killed an estimated 5-10,000 wild birds during the 1999 US outbreak, mainly American crows, but it also affected at least 17 other species of wild and captive native birds, as well as several exotic species in the zoo. Over 20 horses were affected; at least 10 died or were euthanized. One cat may have died of WNV. American health officials responded to the 1999 West Nile Virus outbreak with public education campaigns emphasizing reduction of mosquito habitat, mosquito avoidance and use of repellants; surveillance of mosquitoes, birds, people and horses for West Nile Virus infection; and mosquito control programs.
In 2000 an extensive wild bird surveillance program was in place in New York and other northeastern states, to detect the presence of WNV in the ecosysytem, and thereby to inform and direct public measures aimed at mitigating the risk of human infection. WNV re-emerged in downstate New York and New Jersey in May, and spread northeast, ultimately involving all of Connecticut and Rhode Island, most of Massachusetts and parts of New Hampshire. At the same time it began to involve progressively greater parts of upstate New York, reaching the Canadian border at the Niagara River in early August, and along

the south shore of Lake Erie, the south shore of Lake Ontario and the St. Lawrence, and Quebec south of Montreal by the end of the season. Dead birds infected with WNV were found within 50 km of the Canadian border. Parts of Pennsylvania, Maryland, D.C., Virginia and a single county in North Carolina also had WNV activity by season's end. The public health response triggered by detection of WNV infection in dead
wild birds was similar to 1999; in some areas pesticides were used against mosquitos in the vicinity of a dead bird. Many thousands of wild birds, especially crows, were killed by WNV in 2000. As part of the WNV surveillance program, the virus was detected in over 4000 dead wild birds in the USA in 2000. Twenty one people were recognized with WNV infection in New York, New Jersey and Connecticut; 4 died, all elderly. About 60 horses became clinically ill; at least 23 died or were euthanatized. WNV was detected in 2 bats, and a chipmunk, squirrel, rabbit and a skunk. Mosquito pools also were positive for WNV in the area of the epidemic, and a small number of sentinel chickens in the USA seroconverted by the end of the season. In Canada, surveillance for WNV was implemented by a joint federal-provincial task force in provinces from Saskatchewan east. More than 2200 dead wild birds were accessioned, over 1500 in Ontario. Surveillance for neurologic disease due to WNV in people was carried out, and sentinel chickens were distributed from Saskatchewan to New Brunswick. However, WNV activity was not detected in Canada in 2000, despite the proximity of the infection to the Quebec and Ontario borders.

CANADIAN WEST NILE VIRUS SURVEILLANCE, 2001

By the end of 2000, WNV was present along the entire Canadian border with New York State. WNV may have entered Ontario or Quebec undetected in 2000, since surveillance for WNV in dead birds was much less intensive than in New York State, and varied markedly among Health Units in Ontario. Migratory bird flyways from New England may facilitate movement of WNV into the Maritime Provinces in spring 2001.

In 2001, surveillance for mortalities due to WNV in wild birds is central to the Canadian West Nile Virus response. Dead birds will be collected by public health or wildlife agencies, and submitted to regional centres of the CCWHC. They will collect and forward tissues for WNV detection, which will be carried out by Health Canada in Winnipeg. The goal is early detection of WNV, during the amplification phase. This would trigger public education and possibly other measures to reduce the risk of human infection, if, where and when the situation warrants such action.

Surveillance for dead birds with WNV again will be carried out in provinces from Saskatchewan east. However, the intensity of passive surveillance for dead birds initially will be greater in southern Ontario, the St. Lawrence River Valley and southern Quebec, and in New Brunswick and Nova Scotia, in comparison with Saskatchewan, Manitoba,
Northern Ontario and Quebec, and Newfoundland. Should the circumstances warrant it as the picture develops through the summer, surveillance for dead birds with WNV may intensified in the latter regions.

Health Canada, the Canadian Food Inspection Agency and provincial public and animal health agencies are, monitoring the WNV situation in the USA, where, because of an earlier spring season, WNV activity is expected to occur before it does in Canada. But it is important to realize that if it is already present, WNV may become active in southern Ontario, Quebec and the Maritimes with the spring emergence of overwintering *Culex* mosquitos.

West Nile Virus can cause fatal illness in many species of birds, and in some areas, birds other than crows were found with WNV before crow mortality was detected. However, in the northeastern United States in 2001 it was apparent that crows and related species were particularly susceptible to WNV infection, and therefore good sentinels for the presence of the virus. In New York, dead crows had a higher probability

of being infected with WNV than other dead wild birds, and the incidence of dead crows sighted in a region was correlated with the risk of WNV infection in people, while WNV infection in other species was not.

Accordingly, in Canada in 2001, and in many US states, **surveillance of wild birds for WNV infection will be limited to crows and closely related species** in the family Corvidae (in Canada - crows and blue jays in most areas; ravens and gray or Canada jays in more northerly areas and the Atlantic Region; magpies in the western provinces). This will reduce the workload and expense for agencies fielding reports of dead birds and recovering specimens for submission to laboratories; it should improve the diagnostic rate; and it will optimize the use of expensive and limited laboratory resources. If WNV is detected, federal, provincial and municipal public and animal health agencies will initiate appropriate measures to inform and educate the public, and to mitigate the risk of WNV infection in people and domestic animals.

In addition to dead birds, reports of **sightings of dead corvidae (crows, blue jays, ravens, gray jays in eastern Canada) also will be collected**, as an important adjunct to the laboratory evaluation of carcasses for WNV. Although WNV can not be confirmed on the basis of a sighting of a dead corvid, where it is active WNV is a very significant mortality factor in crows, and risk of human exposure to WNV in New York was related to the incidence of dead crows in an area. Sightings increase the number of observations, and capture information that otherwise would be lost due to a difficult place or time of observation/retrieval, or poor state of preservation of the bird.

Your participation in surveillance for West Nile Virus infection in wild corvidae is essential. You or others with whom you work may be called upon to facilitate submission of dead birds to the laboratory, by advising a member of the public on where to report a dead bird, by initiating collection of dead birds from the field, by collecting and submitting dead birds, or by recording and submitting a sighting of a dead corvid.

The following information will permit you to do this in an effective and safe manner.

REPORTING A SICK OR DEAD BIRD:

The importance of making the public aware of dead bird surveillance for West Nile Virus can not be overemphasized. "If we don't look, we won't find". The public are the "eyes" of the surveillance team. If they are not aware of the program, and do not report sick or dead corvids, the early warning system for WNV will fail. Health Units from all parts of southern Ontario (those to the south of Muskoka-Parry Sound and Renfrew Health Units) are urged to publicize the WNV dead bird surveillance program sufficiently to maintain a flow of sightings and carcasses to the CCWHC, without creating unnecessary alarm. The probability of detecting WNV early is a function of the effort expended in publicising the program and obtaining and submitting carcasses and reports of sightings. In northern and northwestern Ontario the degree of public awareness need not be as high, but any dead corvids reported should be recovered and submitted if possible, and sightings of dead corvids should be submitted to CCWHC. Since the public generally are unable to identify a bird, an attempt should be made to inform them of the appearance of crows and blue jays in southern Ontario, with the addition of ravens and gray jays in northern parts of the province (see appendix).

Members of the public encountering sick or dead wild corvids should report the bird to the local Health Unit. The Health Unit telephone number often is difficult to find in the phone book due to variations in names, and may not be in the Blue Pages. Ensure that the telephone number to call is a prominent part of any publicity.

Agencies such as Ontario Ministry of Natural Resources, Canadian Wildlife Service, Canadian Food Inspection Agency, Provincial and National Parks, Conservation Authorities, Animal Control and/or Humane Societies, veterinarians and rehabilitators may receive enquiries about dead birds. We will tell them to refer public enquiries directly to the local Health Unit; it would be of assistance if Health Units could inform us of the number that they wish the public to call, so that we may communicate that to such agencies and individuals. If dead birds are brought to such agencies or individuals, or are encountered during the course of professional activity, they also may be evaluated according to the criteria below, and if appropriate, referred to the Health Unit or submitted directly to the CCWHC lab in Guelph. **Health Units will be informed of the results of tests for WNV on all birds received from within their jurisdiction, whether submitted by the Health Unit or other sources.**

RESPONSE TO A SICK OR DEAD BIRD

Health Units need to develop local plans for a timely response to reports of sick or dead birds. This response should incorporate 5 steps, described below. First contact with the person finding sick or dead birds normally will be by Health Unit personnel manning telephones. Those employees should be made aware of the organization of the program locally, and be informed about how to deal with calls about dead birds. A protocol needs to be in place for the collection and submission of carcasses to CCWHC, and for reporting of dead corvid sightings in the absence of a carcass. Pick-up and submission of birds may be by Health Unit personnel or by others contracted locally to carry out nuisance or dead animal response. **All persons taking decisions regarding response and submission, and those handling and submitting dead birds, must be familiar with this document.**

1. The person receiving a call records, on a CCWHC West Nile Virus Surveillance Form (appended): date of call, identity/contacts of caller, species involved (if known), condition of carcass(es), and exact location. Based on that information and criteria described below (species, carcass condition, number of birds sick or dead) decide whether the bird should/can/will be picked up, and if possible, inform caller of that decision. **This person will need to try to determine if the bird involved is one of the species of concern, especially a crow or jay** (see Appendix re bird identification for questions to ask). If the bird can't/won't be picked up, inform caller of means of carcass disposal (see below).
2. Despatch, as soon as possible, person responsible for pick-up of bird, if appropriate based on decision in 1.
3. Collection of dead bird: the person doing so revises/completes the WNV Surveillance Form based on identification of species and local observations. A decision is made re suitability for submission, based on informed knowledge of species, condition/appearance of carcass and circumstances of mortality. If bird is not suitable for submission, retrieve and dispose of appropriately.
4. Submit suitable carcass to CCWHC lab, as described below, accompanied by WNV Surveillance Form.
5. If a carcass is not picked up, or if a carcass picked up is not submitted, forward completed WNV Surveillance Form to CCWHC Ontario daily by fax (FAX 519 824 5930); it will be recorded as a 'sighting'.

SPECIES OF PARTICULAR CONCERN:

Submit all carcasses of Corvidae (crows, blue jays, ravens, gray jays) that are suitable for examination (see below).

OTHER SPECIES OF BIRDS

CCWHC also carries out surveillance for diseases other than WNV in birds other than corvidae. Birds of other species should be submitted to CCWHC for autopsy **if there is a clear history of nervous signs** (loss of fear, tremors, convulsions, paralysis, wing droop, immobile limb) in live birds, or **if there**

appears to be an outbreak of disease (several birds of any species reported affected/dead in a local area [~2 km radius] within a period of 2-3 days). Also **submit any raptorial birds** reported (eagles, hawks, falcons, kestrels, owls etc.). A CCWHC Incident Report Form (copy attached) should accompany such submissions if possible; otherwise, use the WNV Surveillance Form.
If it is not feasible to collect and submit such birds, have the person reporting call the CCWHC Communications Coordinator (519 823 8800 Ext 4662) for instructions on how to submit a bird.

A complete autopsy and full diagnostic workup is carried out on all birds other than those submitted for WNV surveillance. If WNV infection is suspected as the cause of death in such a case, it will be submitted for WNV detection as well.

CONDITION OF CARCASS

Birds must be intact and reasonably fresh (not obviously rotten, no maggots or scavenging) for profitable examination. **Birds that have been found on roadsides or obviously have been traumatized are acceptable.** Corvids with WNV seem more susceptible to trauma and misadventure than normal, perhaps because they are sick. Carcasses that are in the open, full sun etc., could be moved to the shade by the person finding the bird, if they are willing (see instructions for handling, below).

Sick or dead Corvidae that cannot be retrieved, or that do not meet the criteria for submission, should be reported as "sightings". As described above, CCWHC WNV Surveillance Forms should be completed and sent to the CCWHC regional lab by Fax.

Due to workload, budget, and capacity of the Health Canada laboratory in Winnipeg, it may be necessary for CCWHC Ontario Region to prioritize the effort that they can expend on particular submissions. A complete examination for cause of death is not normally carried out on WNV surveillance submissions; tissues for WNV detection are all that is retrieved. As well, in the event of a WNV outbreak, effort will be focussed on determining the geographic distribution of infection. Hence, WNV status may not be determined on every carcass, depending on workload and recent WNV activity in the immediate vicinity (carcasses recovered within a small radius of recent WNV cases may not be examined). Should WNV activity become intense in a Health Unit, you may be asked to not submit birds for a period of time; this request will come from the CCWHC Ontario Communications Coordinator, by email or phone. This is to save cost of collection, submission and processing of birds from a known endemic area. In this circumstance, **reports of dead crow/jay sightings should continue to be collected and faxed in.** Even if not processed, every carcass submitted will be accessioned to the database, and may be retained for retrospective examination for WNV infection.

If there is any uncertainty regarding whether-or-not a submission should be made, telephone the CCWHC Communications Coordinator for advice (519 823 8800 Ext. 4662).

HANDLING BIRDS

Although direct transmission of WNV from birds to people is not known to occur, members of the public are to be discouraged from handling birds. If they must do so for submission or disposal, they should follow these guidelines, which also should be followed by all others handling birds.

Live, sick birds should be referred to a local animal control agency, humane society, rehabilitator or collaborating veterinarian for evaluation and, if appropriate, euthanasia, preferably by a method that does not damage the brain. If they meet the species and other criteria, such birds, and those recently-dead of natural causes are ideal submissions.

Birds or carcasses should be handled using an implement such as a small shovel, or by hand if disposable plastic or rubber gloves are worn. Alternatively, carcasses may be placed in a puncture-resistant leak-proof plastic bag of appropriate size by everting the bag over the hand, then grasping the carcass through the bag, and wrapping the bag around the bird without touching it. An ideal leak-proof inner bag for shipping specimens is a large heavy-duty Zip-Loc bag. Zip-Loc bags should be tightly zipped shut; others should be sealed by a twist-tie, knotted string, or by knotting the bag securely on itself. It then should be placed inside a second leak-proof plastic bag, which is similarly sealed. Double-bagging prevents cross-contamination between carcasses and fluid leaks in shipping. Carcasses should be chilled, but not frozen, unless it will be impossible to get them to the lab within 24-36 hours (distance, weekend intervening), in which case they should be frozen. If in doubt about freezing specimens, consult the CCWHC Communications Coordinator for advice.

Carcasses not submitted should be double-bagged and placed in garbage destined for a landfill, or buried several feet deep where they will not be disturbed. Do not dispose of in a manner such that they could be handled again by someone.

People handling birds should wash thoroughly with soap and water afterward.

SUPPLIES REQUIRED FOR SUBMISSION OF A BIRD

Canadian Cooperative Wildlife Health Centre Ontario/Nunavut Region WNV Surveillance Forms: **copy from sample appended**; download from the Internet at http://wildlife.usask.ca; or contact CCWHC Communications Coordinator and request additional forms to be sent by fax or email attachment (see contact information below).

Zip-Loc plastic bags of a size appropriate to enclose WNV Surveillance Forms.
Plastic bags, preferably heavy-duty Zip-Loc bags, big enough to enclose a crow, and strong enough to resist puncture by bills, beaks and claws; secure ties for same, if not Zip-Loc.
Waterproof labels/tags, or small waterproof plastic bags (Whirl-pac) in which to enclose labels/tags; waterproof marking instrument.
Frozen cold packs (not wet ice).
Newspaper and a larger leak-proof plastic bag in which to wrap specimens.
Insulated shipping containers: hard-sided plastic picnic cooler with return address clearly marked.
Heavy packing/shipping/duct tape.

SUBMISSION OF SPECIMENS:

If more than one specimen is being submitted, they should be bagged separately. Bagged carcasses should be identified clearly, using a waterproof writing instrument, on a waterproof label or tag affixed to the carcass, or on paper sealed inside a leak-proof plastic bag, and enclosed inside the bag containing the carcass. **We suggest that each Health Unit develop a coding system for birds submitted from their region, and put the reference number on the carcass tag and on the WNV Surveillance Form in the space provided.** This number will be carried over with other information on the bird to our database, and will assist you in identifying results reported.

A separate WNV Surveillance Form should be filled out legibly for each carcass to accompany the shipment. The form, or forms, if more than one carcass is being submitted, should be enclosed in a Zip-Loc bag and placed in a sealed 8.5 x 11" envelope securely taped on the outside to the side or top of the shipping container.

The WNV Surveillance Form should include the following information; spaces to fill in, or responses to circle, prompt a response to each item on the form:

Name of the person completing the submission form, full mailing address, telephone number, Fax number, email address
Address to send report, if different from above
Date bird reported to Health Unit
Internal reference number used by the Health Unit, if any
Name of the person reporting dead bird(s), full mailing address, telephone number
Location bird found (most specific street or rural municipal address [Twp., Concession, Lot #], including municipality, province or territory and postal code), if possible GIS coordinates (latitude, longitude highest resolution possible]. A specific location, if possible, is very important, to facilitate mapping of each submission for epidemiologic purposes.
Species: circle species name (crow, blue jay, raven, gray jay), or 'unknown', or enter written name of 'other'species. Species of birds submitted will be confirmed by CCWHC, but try to be as accurate as possible with 'sightings'.
Whether carcass was considered appropriate to visit/retrieve: Yes/No
Date carcass visited: picked up/not picked up
Date submitted, or 'Not Sent'
If a bird is not submitted, the information collected by telephone from the person reporting, or by the field investigator, must be submitted by FAX as a 'sighting'. Prompts are in place to stimulate a FAX.

Double-bagged carcasses should be wrapped in several layers of newspaper, which insulates them and absorbs fluid. A freezer pack (not wet ice) should be wrapped in the newspaper with a chilled carcass, but is unnecessary with a frozen carcass. The carcass in newspaper then should be placed in an outer plastic bag which is sealed securely. The wrapped, bagged carcass then should be placed in a hard-sided plastic insulated cooler (which will be disinfected, washed out and sent back, if return addressed). All shipping containers must be securely packed, sufficiently sturdy, and taped shut, to prevent leaks, breakage or opening in handling. **Leakage or breakage of a single package in transit could place the entire shipping system, and therefore the surveillance program, in jeopardy.**

The contents of the parcel must be described as 'DIAGNOSTIC SPECIMEN - WILDLIFE' on the waybill. Do not use any other terms. The packaging and labelling described matches the criteria for transport of carcasses to laboratories during WNV investigations in the USA. **The weight must be marked on the waybill for us to get the concessional rate on shipping charges. Parcels should be under 10 pounds gross weight, if possible.**

Ship by Purolator Courier, collect to:
Canadian Cooperative Wildlife Health Centre,
OVC Receiving, McGilvray St.,
University of Guelph, Guelph, ON N1G 2W1.
[Obtain account number to put on waybill by phone at 519 823 8800 Ext. 4662, or email at ccwhc@ovc.uoguelph.ca]. Do not mark waybills with 'same day', 'early delivery', 'Saturday delivery' etc. This is unnecessary, and very costly.
Packages from anywhere in Ontario routinely arrive the next day, at 0900, Monday-Friday.

Ship on Mondays to Thursdays inclusive, overnight delivery. Do not ship specimens on Friday. Freeze specimens that cannot be shipped to arrive overnight Monday-Friday, and ship on the next appropriate day, bearing in mind any long weekends. **Phone, FAX or Email the CCWHC lab with the waybill # of each shipment**, the day that it is shipped [see phone #, email address above]. This helps us track any shipments that go astray.

Be sure to enclose all WNV Surveillance Forms in a clearly marked envelope taped securely to the outside of the shipping container. **Do not enclose WNV Report Forms in bags with carcasses.**

FURTHER CANADIAN INFORMATION ON WEST NILE VIRUS

Health Canada: http://nile.healthcanada.net

Canadian Cooperative Wildlife Health Centre: http://wildlife.usask.ca

APPENDIX - IDENTIFICATION OF SPECIES OF CONCERN

Species of Concern fall into two categories, Corvidae (the crow and jay family), to be collected for WNV detection, and Other Species, in which we want to detect diseases other than WNV (and WNV if it is present). If there is any doubt about whether a bird is a species of concern, submit it. Be somewhat more rigorous with 'sightings', in which the species cannot be confirmed.

Corvidae

In southern Ontario, only the crow and the blue jay are found.

Crows: - colour - completely black, with black bill and eyes.

- size - flighted young and adults are large birds; up to 45 cm (18") long from tip of bill to tip of tail; one to one and a half times as long as a large man's shoe.

Blue jays: the Toronto Blue Jays baseball team mascot and logo

- colour - bright blue or blue-gray above, blue crest, white face, gray-white underparts
- size - up to about 28 cm (11") long; as long as a large size 10-12 man's shoe.

In northern Ontario, add the raven and gray jay

Ravens: - like a large crow, up to 60 cm (24") long (length of 2 large man's shoes) and totally black, with a heavy straight bill.

Gray jays: - colour - gray all over, darker above and on head, lighter below, with white face; like a 'big chickadee'

- up to about 28 cm (11" long, as long as a large man's shoe; long tail, short beak - the bird in the CCWHC logo on the Surveillance Form).
-

'Confusing' species:

Crows/Ravens: Species that are black, iridescent dark gray or dark brown in colour, and hence might be mistaken most commonly for crows or ravens (starling, cowbird, blackbird, grackle, pigeon, mourning dove) are all much smaller (none larger than 30 cm [12"], the size of a large man's shoe), none are jet black overall, and many have a light coloured white, yellow or red eye.

Blue Jays: No other bird of its size in Ontario is blue, except the belted kingfisher, which is up to 30 cm (1 foot) long, blue-grey, with a white neck band, and has a very large bill. The bluebird is uncommon, much smaller, lacks a crest, and has a blue back and wings with an orange-red chest.

"Other Species"

Raptors: Hawks, Eagles, Falcons and Owls etc. may vary widely in colour and size, but all have sharp talons on large gripping feet, and all have a strong hooked bill. If in doubt, submit.

Outbreaks: It is very important to our role in surveillance for diseases other than West Nile Virus that CCWHC be made aware of outbreaks of disease or of birds with neurologic disease. For instance, in 2000, there was an outbreak in cormorants of Newcastle Disease, which causes neurologic signs due to encephalitis. It was important to differentiate this from WNV infection. This disease can cause devastating losses in farmed poultry, in some pet species, and mild disease in people. So we informed the Canadian Food Inspection Agency, who are concerned about poultry; wildlife agencies which have jurisdiction over wild birds; and wildlife rehabilitators who might be handling these birds. As well, there was an outbreak of a protozoal infection called trichomoniasis in mourning doves throughout southern Ontario, reflected in large numbers of doves among the WNV surveillance submissions in June/July. And a large epidemic of botulism Type E occurred in loons and mergansers (fish ducks) on Lake Erie in the fall.

There is no need to identify species involved in 'outbreaks' of disease. An outbreak can be defined as more than one bird dead in an immediate locality at a time, or reports of more than one bird dead within a small radius (1-2 km) over a period of 2-3 days. If an outbreak is identified or suspected, collect and submit birds to CCWHC, indicating that an outbreak is suspected. If that is not possible, call the CCWHC Communications Coordinator with the name and telephone number of the person reporting dead birds. CCWHC will then attempt to have the birds submitted or retrieved, or have a wildlife agency investigate.

ONTARIO/NUNAVUT REGION
CANADIAN COOPERATIVE WILDLIFE HEALTH CENTRE
Department of Pathobiology, Ontario Veterinary College
University of Guelph, Guelph, Ontario N1G 2W1
Telephone: [519] 823-8800 Ext. 4662 / FAX: [519] XXX-XXXX
email: ccwhc@ovc.uoguelph.ca

WEST NILE VIRUS SURVEILLANCE FORM
(for use in West Nile Virus Surveillance only)
(Use a CCWHC Incident Report Form to report other wildlife disease/mortality incidents)

Date received by CCWHC: Necropsy #: CCWHC #:

Name of person filling out this form: Address for report:

Address

Postal Code
email address:
Phone # [ ]
FAX # [ ]

Postal Code
email address:
Phone # [ ]
FAX # [ ]

Date reported to Health Unit (Yr/Mo/Day) Health Unit Reference #:

Found by (name, mailing address, telephone):

Location where dead bird found: (Full urban street address; Rural Twp., Lot, Concession; Postal Code or GIS coordinates if possible)

Postal Code: _____

GIS: Latitude _____deg _____' _____" N; Longitude: _____deg _____' _____" W

Species: (circle - separate form for each bird, please) Age: Juv Ad Unkn Sex: M F Unkn

Crow Blue Jay (CCWHC use only)
Raven Gray Jay
Unknown Other (write in) _____

Carcass considered worth picking up based on description (circle) Yes **OR** No, not picked up (Sighting only - FAX to CCWHC) (circle/date when done)

Date carcass visited: (Yr/Mo/Day) picked up (circle) **OR** Not picked up (Sighting only - FAX to CCWHC) (circle/date when done)

Date Carcass Submitted to CCWHC: (Yr/Mo/Day) **OR** (circle) Not sent (Sighting only - FAX to CCWHC) (circle/date when done)

Carcass: (circle) Fresh Frozen

Spontaneous death? (circle) Yes No (how killed?)

ONTARIO/NUNAVUT REGION
CANADIAN COOPERATIVE WILDLIFE HEALTH CENTRE
Department of Pathobiology, Ontario Veterinary College
University of Guelph, Guelph, Ontario N1G 2W1
Telephone: [519] 823-8800 Ext. 4662 / FAX: [519] 824-5930
email: ccwhc@ovc.uoguelph.ca

INCIDENT REPORT FORM

(to report wildlife disease/mortality incident, and to accompany any specimen submissions)

Date Submitted: Necropsy No.: CCWHC No.:

Name of Submitter:
Address

Postal Code
email address:
Phone # [ ]
FAX # [ ]

Copy Report to:
Address

Postal Code
email address:
Phone # [ ]
FAX # [ ]

Found by (name, mailing address, telephone):

Locality of Incident: (Urban street address; Rural Twp., Lot, Concession; Postal Code if possible)

Postal Code: _____

Latitude ____deg ___' ___" N; Longitude: _____deg ___' ___" W Mercator Grid:

Species: Age: Sex:
(separate form for each species, please)

Total number of this species: Appearing Normal Sick Dead

Date incident observed: Date incident occurred (if known):

Environmental Circumstances surrounding incident/mortality, in full:
(eg. weather; proximity to buildings, power lines; use of chemicals; human interaction; etc. - use back of form if necessary)

Behavior/Clinical Signs of Affected Animal(s):

Poisoning supected? (circle) No Yes (specify)

Rabies suspect? (circle) No Yes

Other problem or cause of death suspected? (specify)

Specimens (circle appropriate) No To follow (how/when) Yes Incident previously reported to us? If so, when?

Indicate # of each submitted # Carcasses: Fresh Frozen

Parts: Fresh Frozen Fixed

Other: (specify)

Spontaneous death? (circle) Yes No (how killed?)

Appendix 2

Canadian National Guidelines for Human Surveillance for West Nile Virus

West Nile Virus was first identified in the Americas in 1999, and caused an outbreak of viral encephalitis in humans centered around New York City (NYC). The outbreak resulted in 61 human cases of which 55 were confirmed, including 7 deaths. The epidemic/ epizootic also affected American Corvids, exotic birds and horses, with high mortality.

West Nile Virus (WNV) is a mosquito-borne flavivirus transmitted principally by *Culex* species mosquitoes. The virus belongs taxonomically to the Japanese encephalitis serocomplex that includes the closely related St. Louis encephalitis. It was first isolated in Uganda in 1937. The first recorded epidemics occurred in Israel in 1951-4 and 1957. The largest epidemic occurred in South Africa in 1974. European epidemics have occurred in 1962 in southern France, Romania in 1996 and Russia in 1999.

WNV infects a wide range of vertebrates, and the ecology of the organism including the mechanism of its persistence in a geographic area is poorly understood. In humans WNV causes asymptomatic infection or mild febrile disease, sometimes with a rash, but can cause severe illness and death in a small percentage of patients. Severe muscle weakness was a prominent feature among human cases of WNV in New York City, and occurred among 40% of confirmed cases. Serosurvey data from a study conducted in October 1999 in the geographic area of highest WNV incidence in NYC, demonstrated the presence of WNV antibody in 2.6% (19 of 677, CI95 1.2% - 4.1%) of persons aged 5 years and older who were asymptomatic or had a mild illness. These findings were comparable to those in Romania related to the 1996 outbreak.

In birds, WNV usually causes asymptomatic or mild infection but in the NYC outbreak was associated with high rates of mortality among select bird species, and this is substantiated by prior experimental data from Egypt in hooded Corvids and house sparrows. The method of importation of the WNV into NYC is unknown, but it may have arrived in an infected human, bird (including a migratory bird), or in mosquitoes.

Surveillance for the presence of WNV includes monitoring its presence in:

- Birds – migratory and peri-domestic, as well as sentinel chickens and dead bird surveillance
- Domestic animals, including horses
- Mosquitoes
- Humans.

Human surveillance should ideally be an adjunct to the other types of surveillance listed above, and not the sole source of information about the presence of WNV in the community. However, it may be the only source of information in areas without sufficient resources to carry out surveillance in other species, or areas where the risk of WNV activity is deemed to be exceedingly low.

A conference about WNV hosted by Health Canada was held in Ottawa on February 10-11, 2000. It brought together a multi-disciplinary group of people from the animal and human health sectors, as well as ornithologists and laboratory expertise. The data presented and recommendations made at the conference are the basis for the following guidelines.

Objectives of Human Surveillance:

The objectives of human surveillance are:

- the timely identification of human cases of viral encephalitis caused by West Nile Virus in a geographic area due to endemically acquired infection, as well as importation
- to reduce further transmission of WNV infection to humans
- to monitor the epidemiology (e.g., age distribution, clinical presentation, risk factors, outcomes) among cases of WNV encephalitis
- to provide information about results of human surveillance to the public, health professionals and governments
- to use results to step up control measures to reduce mosquito exposure, and
- to compare the results of human surveillance to those of non-human surveillance for evidence of WNV activity.

Surveillance activities may vary in intensity depending on the level of risk deemed present in the geographic area based on prior history of endemic arbovirus infections, mosquito activity, proximity to geographic areas where WNV has been identified in animals or humans, and following identification of WNV locally in animals or humans. Three levels of WNV activity were defined at the February 2000 meeting:

I. Absence of confirmed bird/ domestic animal/ wildlife infection.
II. Confirmed bird/ domestic animal/ wildlife infection but no reported human illness.
III. Confirmed bird/ domestic animal/ wildlife infection and human illness reported among persons whose history suggests endemic acquisition of infection.

It is vital that all levels of public health agencies form linkages with the appropriate animal health personnel in their own jurisdiction in early spring to ensure that identification of potential

or confirmed illness in birds, wildlife or domestic animals is promptly investigated and that reporting to public health officials occurs.

Reportability of viral encephalitis: Viral encephalitis is no longer a nationally notifiable disease, and reporting requirements may differ in various Canadian jurisdictions. Effective surveillance can be carried out for diseases which are not notifiable under legislation/ regulation; however, reporting requirements will need to be taken into account in designing the surveillance program in each jurisdiction.

Timing and geographic area for human surveillance: Surveillance should commence in early to mid-May in and continue until the first autumn frost, i.e., in keeping with mosquito season. Based on migratory bird flyways, the February conference recommended that surveillance be undertaken in all jurisdictions east of Alberta.

Clinical syndromes for surveillance: Based on the NYC outbreak, surveillance for viral meningitis was non-productive, and these cases were almost uniformly due to other (e.g., enteroviral) causes. Therefore, surveillance among humans should be restricted to **encephalitis** and include all age groups. The background incidence of human encephalitis is low. A pediatric encephalitis active surveillance program based out of the Hospital for Sick Children, Toronto, and covering a population base of 3 million in southern Ontario, identifies an average of 40 cases per year among those aged 18 years and under, due to a wide variety of infectious agents including herpes simplex virus, cytomegalovirus, enteroviruses and respiratory viruses including influenza. Peaks occur in the late summer and late December.

Encephalitis due to arboviruses including WNV cannot be confirmed based on clinical findings alone. Most clinically apparent infections are manifest as acute febrile illnesses associated with a wide range of neurologic manifestations. Symptoms may include headache, stiff neck, nausea, vomiting and alterations in the level of consciousness (from mild lethargy to coma) or mental state (from mentally alert to confusion, delirium or disorientation). Virtually every possible type of focal neurological disturbance has been reported in viral encephalitis, with signs and symptoms reflecting the sites of infection and inflammation. Signs may include fever, meningismus, cranial nerve deficits, paresis or paralysis, sensory deficits, altered reflexes, involuntary movements and focal or generalized seizures. In the New York City outbreak of WNV encephalitis, fever (98% of cases), altered mental status (64%) and profound muscle weakness (40%) were notable features of the illness.

Enhanced passive surveillance: As a minimum, each jurisdiction conducting surveillance should carry out enhanced passive surveillance. This entails providing information at the start and periodically during the surveillance season to key health care providers including emergency room physicians, hospital infection control personnel, infectious disease specialists and neurologists, about the possibility of WNV in the jurisdiction and the need to consider this cause in the differential diagnosis of viral encephalitis. Information should include: the clinical presentation of WNV encephalitis, diagnostic specimens to collect, what information to record on the laboratory requisition, how to submit specimens to the public health laboratory, and when and how to report to the local public health department. A Patient Report form is provided on the

next two pages. To encourage reporting, feedback of the results of surveillance should be provided through appropriate venues such as bulletins in the medical association newsletter or health department newsletters, postings in local hospitals or presentations at rounds, and directing interested persons to available web sites.

WEST NILE VIRUS
HUMAN SURVEILLANCE
Patient Report

(Please print; complete all areas except those that are shaded)

DEMOGRAPHICS

Hospital Site _____ Reported By

_____

Responsible MD _____

Patient Name _____ Date of Birth (dd/mm/yy)

_____

Patient Hospital Number _____ OHIP _____ Gender: Male

Female Unknown

Patient phone number _____ Patient address

_____

_____ PostalCode of residence

_____

ADMISSION HISTORY (Please include whatever information is available and forward to Public Health)

Admit Date (dd/mm/yy) _____ Symptom onset (dd/mm/yy) _____ Diagnosis

_____

Discharge Date/Date of death (dd/mm/yy) _____ Discharge Diagnosis

_____

Was this ENCEPHALITIS MENINGITIS GUILLIAN BARRE Other

_____

Was there a FEVER? Yes No Unknown

Was there FLUCTUATING LEVEL OF CONCIOUSNESS? Yes No Unknown

Was there MUSCLE WEAKNESS? Yes No Unknown

Was there a RASH? Yes No Unknown

1st serum taken? Yes No Unknown If yes, when (dd/mm/yy) _____

Was CSF examined? Yes No Unknown If yes, when (dd/mm/yy) _____

In hospital lab results? CSF cells: _____X 10 /L RBC _____X 10 /L

WBC Differential: Neutrophils _____ Lymphocytes _____ Mononuclear cells _____ Other _____

CSF Protein: _____g/L CSF Glucose: _____mmol/L

Was CSF sent for West Nile Virus Testing? Yes No Unknown

If the patient died were pathology specimens tested? Yes No Unknown

In the previous two weeks was there

Camping/cottage visit? Yes No Unknown If yes, please state where_____

Travel to the eastern U.S.A.? Yes No Unknown If yes, City/State _____

Other travel? Yes No Unknown If yes, City/Country _____

Has the patient received Yellow Fever vaccine in the past? Yes No Unknown

Has the patient received Japanese B vaccine in the past? Yes No Unknown

[redacted]

2nd serum taken? Yes No Unknown If yes, when (dd/mm/yy) _____

[redacted]

Please Fax to:

Fax Number:

Active surveillance: Active surveillance coordinated with selected sentinel acute care hospitals may be considered by any jurisdiction, but must begin following the first laboratory confirmation of a human case (level III). Sentinel hospitals should be selected in geographic areas according to likelihood of endemic WNV activity. Key contacts in selected (or all) acute care hospitals in the jurisdiction should be identified and asked to report cases of viral encephalitis weekly. They should be contacted by the surveillance coordinator to follow up on missing reports or missing data, and to maintain interest.

Each case consistent with the clinical case definition below should be serologically screened for WNV by acute and convalescent serology. If a CSF specimen is collected and parameters are consistent with a viral infection, a portion should be sent to the public health laboratory in anticipation of testing methods being available in the near future. Every attempt should be made to collect post-mortem specimens from cases, which meet the case definition (see Diagnostic specimens for viral diagnosis, below).

Outbreak investigation: Outbreak investigation and response teams should be integrated in the current public health response capability. Teams should include representatives of local/ regional and provincial/ territorial public health agencies, laboratories, the Laboratory Centre for Disease Control, the Canadian Food Inspection Agency, the Canadian Cooperative Wildlife Health Centre, and others as appropriate to the jurisdiction.

Case definition:

Suspect Case: a person with a febrile illness **AND** associated neurological manifestations consistent with a diagnosis of viral encephalitis, especially altered mental status and/or muscle weakness (including suspected cases of acute flaccid paralysis or Guillain-Barre syndrome).

Note: This definition excludes persons with a clinical diagnosis of viral meningitis without evidence of encephalitis. However, if a CSF sample has been collected from **an adult** case of viral (aseptic) meningitis, it should be forwarded to the public health laboratory, so that it is available for testing.

Confirmed Case: Confirmed cases should be reported immediately by telephone to the local medical officer of health, who should in turn report immediately by telephone to the appropriate provincial/ territorial public health authorities. A confirmed case is a person with a febrile illness consistent with the suspect case definition **and** at least one of the following:

(a) a 4-fold or greater change in haemagglutination inhibition (HI), confirmed by plaque reduction neutralizing (PRNT) antibody titre to WNV in paired acute and convalescent* sera

or

(b) isolation of WNV from, or demonstration of WNV antigen or genomic sequences in, tissue, blood, cerebrospinal fluid (CSF), or other body fluid

or

(c) demonstration of IgM antibody to WNV in CSF by IgM-capture enzyme-linked immunosorbent assay (ELISA)

or

(d) demonstration of both IgM (by ELISA) and IgG (screened by ELISA and confirmed by PRNT) antibody to WNV in a single serum specimen.

Diagnostic specimens for viral diagnosis:

•paired samples of serum should be collected during the acute phase (1 to 8 days post-onset) and convalescent phase (10-14 days post-onset). Practically, this may be best achieved by collecting specimens upon hospital admission and discharge. However, if discharge is less than 10-14 days post-onset, a subsequent convalescent serum sample should be collected.

Serum for serology should be collected in two red-top tubes and 5-10 ml should be collected in each tube.

If CSF is collected, 1 to 2 cc should be collected in each of two tubes without any preservatives. It should be kept frozen on dry ice or in a –70C freezer until picked up for transport to the public health laboratory.

Brain biopsies taken on persons with viral encephalitis should be tested for WNV. For fatal cases, every attempt should be made to collect heart blood and brain samples, especially the brainstem, for PCR and immunohistochemistry, and from the spleen and liver for immunohistochemistry. A portion of these samples should be kept frozen on dry ice or in a –70C freezer until picked up for transport to the public health laboratory, and should **not** be formalin-fixed.

Human specimen collection, handling and shipping

Physicians and other health professionals should be reminded to handle potential WNV specimens as they would any other blood-borne pathogen, using routine precautions (universal precautions plus gloves for mucous membrane, etc.).

Current laboratory diagnostic capacity for WNV in humans in Canada is as follows:

Laboratory Centre for Disease Control (LCDC) in Winnipeg: serology (HI, neutralization), PCR and isolation. ELISA testing is under development.

Ontario, and possibly Manitoba central public health laboratories: serology (HI only)

Serologic testing by HI is not specific for WNV, and if an individual has been exposed to or immunized against St. Louis encephalitis, dengue, yellow fever, and Powassan viruses, they may test positive for WNV. These results must therefore be confirmed by neutralization testing, currently only available at LCDC. Following confirmation by neutralization testing (or other confirmatory testing) of the index case in an outbreak, confirmation by ELISA can generally be relied upon for subsequent cases. In the absence of availability of ELISA methods, confirmation by neutralization testing should continue to be used and HI alone is insufficient.

The following information should be recorded on the laboratory requisition:

Name, age (date of birth), sex, address of residence including postal code, health card number, physician name and telephone/ pager number, date of onset, symptoms (including fever, altered mental status, and whether meningitis or encephalitis clinically), the type of specimen, date of specimen collection, travel history, and other relevant history (e.g., camping trip), and the request for "arbovirus" testing for suspect West Nile Virus infection. If a blood specimen, state whether it is acute or convalescent.

Additional history should be obtained from confirmed cases, including detailed environmental exposures to identify potential for mosquito bites, travel history, immunization history (including Japanese encephalitis, yellow fever, and other arbovirus vaccines), country of birth, outcome, sequelae.

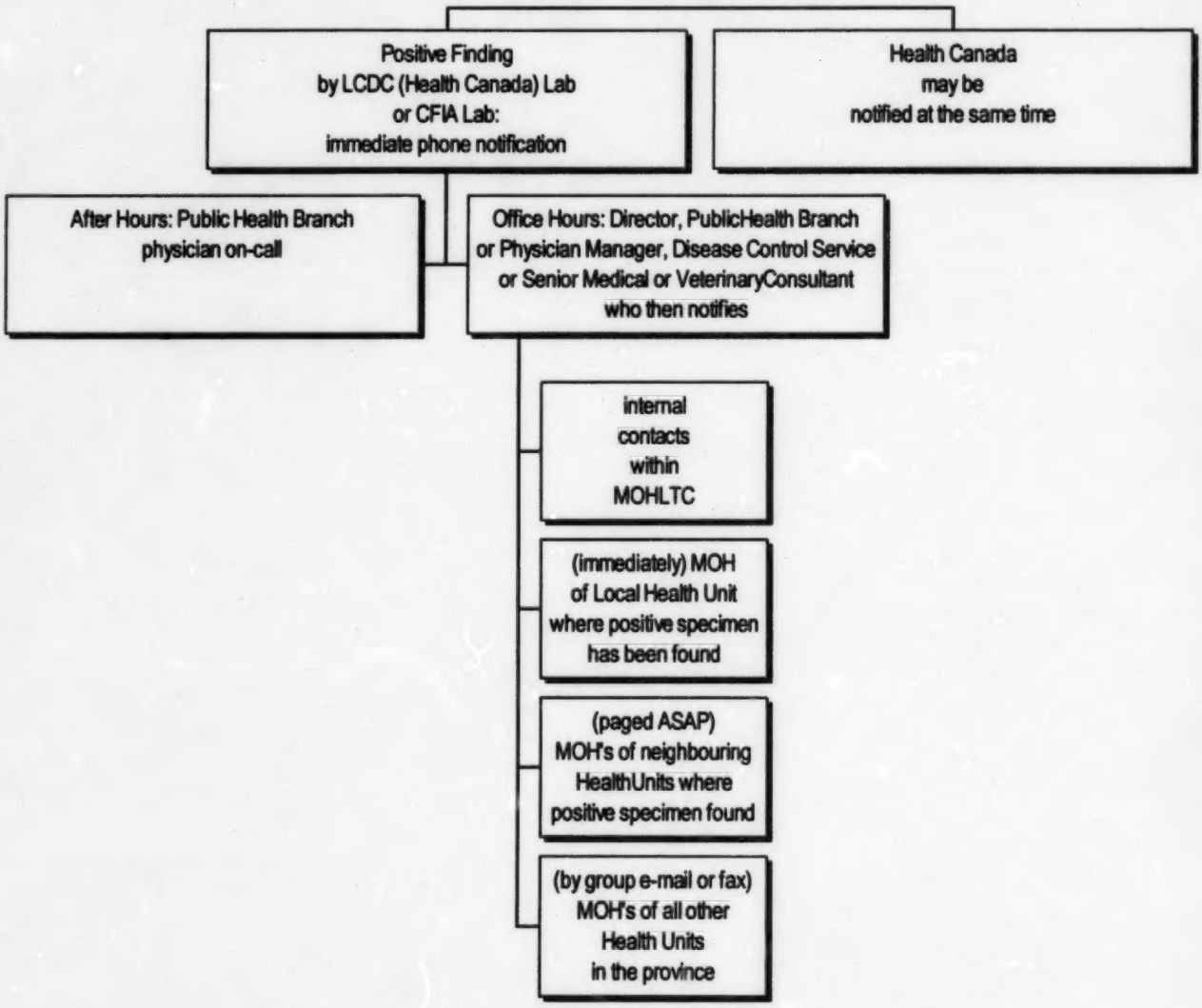
Each provincial/ territorial jurisdiction should establish a rapid reporting mechanism to the Laboratory Centre for Disease Control to ensure that national surveillance is timely and comprehensive.

Public education and outreach. The public should be informed about ways to avoid mosquito exposure. In the event of human cases of endemically acquired WNV, intense communication should be undertaken about mosquito control activities including health impacts, and personal protective measures.

Appendix 3

Reporting Routes and Timing

Reporting Flow of Positive Finding for West Nile Virus



Appendix 4

Mosquitoes of Southern Ontario

Host Preferences

*** Not found in Ontario**

Genus and Species (WNV carriers in bold)	Host Preferences
Anopheles	
• *barberi*	man, larger mammals, sometimes birds and rarely reptiles
• *earlei*	
• ***punctipennis***	
• *quadrimaculatus*	
• *walkeri*	
Culex	
$ ***pipiens***	birds, man and mammals are secondary hosts
$ ***restuans***	birds, man and mammals are secondary hosts
$ *territans*	birds, amphibians, reptiles
$ ***salinarius*** *	birds
Culiseta	
$ *culiseta*	birds primarily but also mammals and man
$ *impatiens*	
$ *inornata*	birds primarily but also large mammals
$ *melanura*	
$ *minnesotae*	
$ *morsitans*	birds
Coquillettidia (Mansonia)	
$ *pertubans*	birds and large mammals
Psorophora	
$ *ciliata*	
$ *columbiae (confinnis)*	
$ ***ferox***	
Uranotaenia	
$ *sapphirina*	
Wyeomyia	
$ *smithii*	

Appendix 4: *Mosquitoes of Southern Ontario* **Host Preferences (continued)**

Genus and Species (WNV carriers in bold)	Host Preferences
Orthopodomyia $ *alba* $ *signifera*	
Toxorhynchytes $ *rutilis septentrionalis*	nectar, larvae predacious on other larvae
Aedes $ *abserratus* $ ***albopictus*** * $ *atropalpus* $ *aurifer* $ *barri* $ *campestris* $ *canadensis* $ ***cantator*** $ *cinereus* $ *communis* $ *decticus* $ *diantaeus* $ *dorsalis* $ *excrucians* $ *fitchii* $ *flavescens* $ *hendersoni* $ *implicatus* $ *intrudens* $ *provocans* $ *punctor* $ *rempeli* $ *riparius* $ *sticticus* $ *stimulans* $ *thibaulti* $ *trichurus* $ ***vexans***	- all *Aedes spp.* - mostly mammals but also birds above plus reptiles above and reptiles
Ochlerotatus (formerly in ***Aedes***) $ ***triseriatus*** $ *trivittatus* $ ***japonicus*** *	

Appendix 4 (continued): *Mosquitoes of Southern Ontario*

Breeding Site Preferences

Genus and Species (WNV carriers in bold)	**Life Cycle** (explanation of numbers follows this table) and **Breeding Site Preferences**
Anopheles	- all in permanent or semi permanent water
• *barberi*	
• *earlei*	
• ***punctipennis***	
• *quadrimaculatus*	
• *walkeri*	12
Culex	
$ ***pipiens*** (dusk-dawn biter)	9 (polluted water in containers/permanent or semi-permanent water)
$ ***restuans*** (dusk-dawn biter)	9 (containers/permanent or semi-permanent water/ditches)
$ *territans*	9 (exposed water)
$ ***salinarius*** * (dusk-dawn biter)	8
Culiseta	
$ *culiseta*	(shaded water/permanent or semi-permanent water/ditches)
$ *impatiens*	9 (permanent or semi-permanent water/ditches/containers)
$ *inornata*	10
$ *melanura*	2
$ *minnesotae*	2 (exposed water)
$ *morsitans*	
Psorophora	- road side ditches
$ *ciliata*	4
$ *columbiae (confinnis)*	4
$ ***ferox*** (day and night biter)	4
Uranotaenia	
$ *sapphirina*	
Wyeomyia	
$ *smithii*	13 (Pitcher plant leaves)
Orthopodomyia	
$ *alba*	13 (container)
$ *signifera*	13 (container)

Genus and Species **(WNV carriers in bold)**	**Life Cycle** (explanation of numbers follows this table) and **Breeding Site Preferences**
Toxorhynchytes	
$ *rutilis septentrionalis*	13
Aedes	
$ *abserratus*	2 (temporary forest pools/permanent or semi-permanent water/exposed open pools/ditches)
$ ***albopictus*** *	6
$ *atropalpus*	1 (rock pools)
$ *aurifer*	2
$ *barri*	
$ *campestris*	
$ *canadensis*	3 (shaded water/rock pools)
$ ***cantator***	5
$ *cinereus*	3 (temp. forest & semi-shaded meadow/permanent or semi-permanent water/exposed open pools)
$ *communis*	1 (temp. forest pools/exposed open pools)
$ *decticus*	2
$ *diantaeus*	1
$ *dorsalis*	4
$ *excrucians*	1 (temp. forest & semi-shaded meadow pools/permanent or semi-permanent water/exposed open pools/ditches)
$ *fitchii*	2 (temp. forest & semi-shaded meadow pools/permanent or semi-permanent water/exposed open pools)
$ *flavescens*	4
$ *hendersoni*	6
$ *implicatus*	1 (temp. forest & semi-shaded meadow pools/permanent or semi-permanent water/ditches)
$ *intrudens*	1 (temp. forest & semi-shaded meadow pools/permanent or semi-permanent water)
$ *provocans*	1
$ *punctor*	1 (temp. forest & semi-shaded meadow pools/exposed open pools/rock pools)
$ *rempeli*	1
$ *riparius*	4
$ *sticticus*	3 (flood water/permanent or semi-permanent water/temp. forest pools/ditches)
$ *stimulans*	1 (temp. forest pools/permanent or semi-permanent water)
$ *thibaulti*	6 (tree holes/artificial containers)
$ *trichurus*	4 (temp. forest pools/permanent or semi-permanent water/exposed open pools)
$ ***vexans*** (dusk to dawn)	4 (flood water/permanent or semi-permanent/temp. forest &

Genus and Species **(WNV carriers in bold)**	**Life Cycle** (explanation of numbers follows this table) and **Breeding Site Preferences**
	semi-shaded meadow/exposed open pools/ditches)
Ochlerotatus (formerly in *Aedes*)	
	14
$ ***triseriatus*** (day biter)	1 (temp. forest & semi-shaded meadow/permanent or semi-permanent water/exposed open pools)
$ *trivittatus*	
$ ***japonicus**** (day biter)	6 (tree holes/artificial containers - tires)

*** Not in Ontario**

Explanation of Life Cycle Numbers

Life Cycle 1
- $ Desiccation resistant eggs laid in ground depressions
- $ Larvae develop in woodland snow pools high in leaf tannin (brown water)
- $ Single generation in early spring
- $ Overwinters in the egg stage

Life Cycle 2
- $ Desiccation resistant eggs laid above waterline in saturated soil habitats
- $ Larvae develop in swamps and bogs
- $ Single generation in early spring
- $ Overwinters in the egg stage

Life Cycle 3
- $ Desiccation resistant eggs laid in ground depressions
- $ Larvae develop in a wide range of transient freshwater habitats
- $ Major generation in early spring followed by sporadic egg hatch later in the season
- $ Overwinters in the egg stage

Life Cycle 4
- $ Desiccation resistant eggs laid in ground depressions
- $ Larvae develop in a wide range of transient freshwater habitats (floodwaters)
- $ Multiple generations each year
- $ Overwinters in the egg stage

Life Cycle 5
- $ Desiccation resistant eggs laid on a substrate that will be flooded by lunar tides
- $ Larvae develop in salt marsh pools
- $ Multiple generations each year
- $ Overwinters in the egg stage

Life Cycle 6
- $ Desiccation resistant eggs laid above the waterline in a container habitat (e.g. tree hole)
- $ Larvae develop in a wide range of natural and artificial containers
- $ Multiple generations each year depending on rainfall
- $ Overwinters in the egg stage

Life Cycle 7
- $ Non-desiccation resistant eggs laid directly on water
- $ Larvae develop in freshwater swamp habitats (clean water with emergent plants)
- $ Multiple generations each year
- $ Overwinters as a mated female

Life Cycle 8
- $ Non-desiccation resistant eggs laid directly on water
- $ Larvae develop in permanent brackish water habitats
- $ Multiple generations each year
- $ Overwinters as a mated female

Life Cycle 9
- $ Non-desiccation resistant eggs laid directly on water
- $ Larvae develop in polluted water habitats (usually urban)
- $ Multiple generations each year
- $ Overwinters as a mated female

Life Cycle 10
- $ Non-desiccation resistant eggs laid directly on water
- $ Larvae develop in freshwater swamp habitats
- $ Multiple generations each year
- $ Overwinters in the larval stage

Life Cycle 11
- $ Non-desiccation resistant eggs laid directly on water
- $ Larvae develop in fresh water swamp habitats (larva and pupa breathe through underwater penetration of plant stems)
- $ Single generation each year
- $ Overwinters in the larval stage

Life Cycle 12
- $ Non-desiccation resistant eggs laid directly on water

- $ Larvae develop in fresh water swamp habitats
- $ Multiple generations each year
- $ Overwinters in the egg stage and develops into a larvae in late winter/early spring

Life Cycle 13

- $ Non-desiccation resistant eggs laid directly on water in container habitats (e.g. Pitcher plants/ treeholes)
- $ Larvae develop in natural or artificial containers
- $ Multiple generations each year
- $ Overwinters in the larval stage

Life Cycle 14

- $ Breeds in subterranean crypts, in dark recesses of upturned trees, under the base of hollowed out trees
- $ Single generation
- $ Overwinters as eggs if larval habitat is dry in fall or in the 2nd/3rd larval stage

Appendix 5

Source: Health Canada (Pest Management Regulatory Agency), May 2001. Health Canada website: www.hc-sc.gc.ca/. . .)

SAFETY TIPS ON USING PERSONAL INSECT REPELLENTS

General Use Information

- Always read the entire label carefully before using.
- Apply the repellent sparingly, and only on exposed skin surfaces or on top of clothing. Do not apply under clothing. Heavy application and saturation are unnecessary for effectiveness. Repeat applications only as necessary and according to label directions.
- Do not get in eyes. If you do get repellent in your eyes, rinse immediately with water.
- Do not use the repellent on open wounds, or if your skin is irritated or sunburned.
- Avoid breathing spray mists and never apply sprays inside a tent. Use only in well-ventilated areas. Do not use near food.
- Wash treated skin with soap and water when you return indoors or when protection is no longer needed.
- Keep all insect repellent containers out of the reach of children.
- Always supervise the application on children.
- Avoid applying repellent to children=s hands to reduce the chance of getting the repellent in their eyes and mouths.
- If you suspect that you or your child are reacting to an insect repellent, stop using the product immediately, wash treated skin and seek medical attention. When you go to the doctor, take the product container with you.
- If you are concerned that you are sensitive to a product, prior to general use apply the product to a small area of skin on your arm, then wait 24 hours to see if a reaction occurs.

Choosing A Product

- Choose a product that meets your needs. For example, if you plan to be outdoors for a short period of time, choose a product with a lower concentration of repellent (shorter protection time) and repeat only if you need a longer protection time.
- Use only personal insect repellents that are registered in Canada. They have a registration number granted under the *Pest Control Products Act* and are labelled as insect repellents for use on humans. Never use a product labelled as an *insecticide* on your body. Some personal insect repellent products contain a sun screen or skin lotion. It is recommended that such

combination products be used **solely** as insect repellents, and be applied according to the safe practices listed above, ie., not spread liberally as one might a sun screen or skin lotion.

- Health Canada's Pest Management Regulatory Agency (PMRA) is conducting a re-evaluation of the active ingredients in personal insect repellents, including DEET and oil of citronella. Re-evaluations involve a comprehensive review of the scientific data that support the registration of pest control products.

DEET Products

These safety tips on DEET are based on the PMRA's re-evaluation as mentioned above. Follow the label information regarding general use precautions plus the new safety recommendations found below.

DEET Use on Children

Although current labels on insect repellents containing DEET state that these products are not to be used on children under the age of 2 years (infants or toddlers), in light of the PMRA=s re-evaluation of DEET, which included input from the Canadian Pediatric Society, it is now recommended that:

- **on children under 6 months of age,**
  - < insect repellents containing DEET **still not be used**
- **on children aged 6 months to 2 years,**
  - < the use of 1 application per day may be considered in situations where a high risk of complications from insect bites exist
  - < the product be applied **sparingly** and not be applied to the face and hands;
  - < only the least concentrated product (10% DEET or less) should be used
  - < prolonged use be avoided

X **on children between 2 and 12 years of age,**

- < the least concentrated product (10% DEET or less) be used and that it be applied no more than 3 times per day.

DEET Use on Adults

X Products containing no more than a 30% concentration of DEET will normally provide adults with sufficient protection. Studies have shown that products with lower concentrations of DEET are just as effective as the high concentration products, but they remain effective for shorter periods of time.

- < 30% DEET will provide 6.5 hours of protection;
- < 15% DEET will provide 5 hours of protection;

- < 10% DEET will provide approximately 3 hours of protection, and
- < 5% DEET will provide approximately 2 hours of protection.

X Products that contain DEET and di-n-propyl isocinchomeronate (MGK Repellent 326) or DEET and n-octyl bicycloheptene dicarboximide (MGK Synergist 264) do not appear to offer any added protection from mosquito bites in comparison to products that contain DEET alone, so their use could result in unnecessary chemical exposure.

X There is no indication that there is a hazard to the unborn or nursing child associated with the use of DEET by pregnant or lactating women. However, there are non-chemical methods to reduce mosquito bites (protective clothing, avoiding mosquito habitat and times of peak mosquito activity) which could be considered.

Products Containing Citronella or Lavender Oil

The re-evaluation of citronella and lavender oil is currently under way at the PMRA. Follow the label information regarding general use precautions and the safety recommendations found above.

X It is recommended that personal insect repellents such as citronella and oil of lavender **not be used on children under two years of age.**

X The citronella oil repellents registered in Canada protect people against mosquito bites for **less than one hour**. The registered lavender oil repellent protects for **half an hour or less**.

X Based on animal studies, citronella-based products appear to be potential dermal sensitizers. Therefore, allergic reactions may occur in some individuals